International Edition

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73®

Amateur Radio's Technical Journal

A CWC/I Publication

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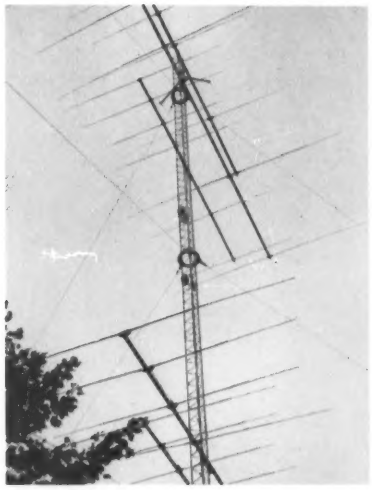

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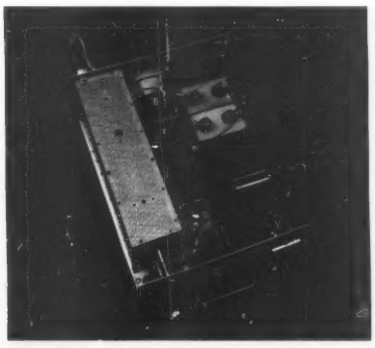

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editorial by Wayne Green

The response to my editorial asking for letters from hams interested in a DXpedition to Taiwan has been underwhelming. One.

I visited Tim Chen BV2A, the only licensed amateur on Taiwan, in October and he is still enthusiastic. He says that the government will cooperate if there are any Americans interested in operating from this very rare country for a few days.

I was looking at this DXpedition as a test to see if there would be any interest in *73* organizing a series of DXpeditions to the rarer countries. I had in mind DXpeditions with about a dozen hams so we would be able to operate stations around the clock for about four days in each spot. This would make most trips last about a week—allowing one day to get there, one to set things up, four days to operate, and one to get home.

By running a series of DXpeditions, *73* would be able to assign one ham full-time to organizing the efforts, going along to help with the formalities, and setting up the stations. A second ham would be in charge of the filming and videotaping of the DXpedition, as well as the PR for it, nationally and internationally.

Here is the group of hams that got together for dinner in Hong Kong in October—about a dozen VS6 and a dozen US hams.

Such a DXpedition series could generate considerable interest in amateur radio via exposure on television and in magazines and newspapers.

Indeed, we need something dramatic such as this if the hobby is going to survive. I doubt if you realize how far down the new ham numbers have sunk. Just this year we've dropped from almost 3,000 new hams a month to about 700. If the curve of new licensees of the last two years continues as it has, we will reach zero per month in 1986.

While we have had a slight growth in the number of total licensed hams in the last twenty years, surveys indicate that much of this is due to the license being free and running for five years. The number of active American hams has dropped by about 46% in twenty years. We sure need something!

A series of well-publicized DXpeditions could conceivably generate interest in the hobby. I estimate that it would cost about $3,000 for each of a dozen hams going on the trip to make

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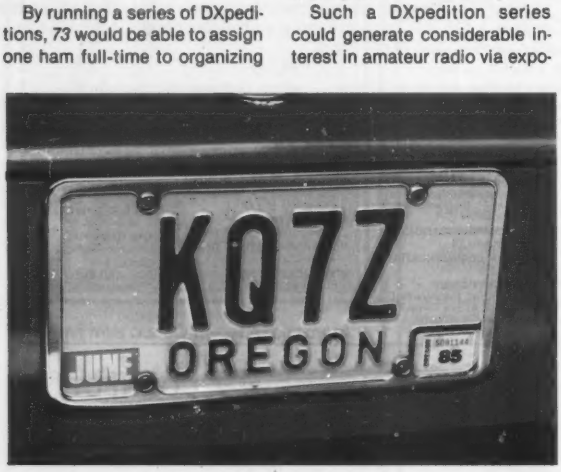

QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, 80 Pine Street, Peterborough NH 03458, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

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TS-930S Optional Accessories: AT-930 automatic antenna tuner, SP-930 external speaker, with selectable audio filters, YG-455C-1 (500 Hz), YG-455CN-1 (250 Hz), YK-88C-1 (500 Hz) CW filter, YK-88A-1 (6 kHz) AM filter, all plug-in type, SO-1 commercial stability TCXO, MC-60A deluxe desk microphone, MC-80 and MC-85 communications microphones, MC-42S mobile hand microphone, TL-922A linear amplifier (not for CW QSK), SM-220 station monitor, PC-1A phone patch, SW-2000 SWR/power meter, 160 – 6 meter, SW100A SWR/power/volt meter 160 – 6m HS-4, HS-5, HS-6, and HS-7 headphones.

Isn't it about time you stepped into the winner's circle?

More information on the TS-930S is available from authorized dealers of Trio-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220.

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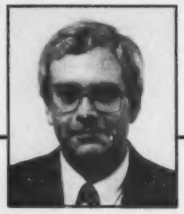

WHAT?

NEWS FROM THE PUBLISHER

Welcome to our 25th Anniversary year!

As publisher, it's my job to make sure that *73* remains the best *vox clamantis in deserto* in the world of amateur radio. As readers, it's your duty to make sure that your voices are heard. More on that later.

We have a few changes in store for this year, including making sure that *73* offers more operating tips and news than we've had in the past. We'll also provide more of a forum for our readers. You asked for it, you get it.

Upcoming new features? Watch for:

- "Believe It or Else" (guest editorials)
- "Dear Advertiser" (unedited answers)
- "*73* Thanks..." (Elmers, emergency ops, PR efforts, etc.)
- "Ask an Extra" (KW1O fields the question of the month)
- "*73*-on-the-Air" (regular skeds return to ARS W2NSD/1)
- "Who's This?" (puzzle profiles of *73* staffers and advertisers)
- "Seen a 73?" (photos of unusual 73s)
- "*73* Congratulates..." (job promotions, ticket anniversaries, hamfest reports, etc.)

Another new feature you'll be seeing is more letters. So write. Try not to be *too* wacko. And don't think that writing isn't important, either. It is.

Write a short letter or send a card to an advertiser, too. When was the last time you spent 15 minutes and 20 cents to thank someone for advertising with a bunch of renegades like us? You're in the driver's seat, sure: 72.6% of you will spend more than $250 on ham gear during the next six months, according to our July-September, 1984, reader surveys. But sending a thank-you has never hurt anyone.

Two final news notes:

- If you have a contribution for any of our new features, send it to me. The sooner we get it, the sooner we print it.
- Set aside Sunday, March 24, for H-Day. Details next month.

Again, welcome to our 25th Anniversary year! Take part. For almost a quarter of a century, *73* has fought for you, in spite of you, and because of you. Thanks.

Jack Burnett

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QRX. . .

EDITED BY PERRY DONHAM KW1O

WARC Wish?

THE WARCS ARE COMING! The FCC has released a Notice of Proposed Rulemaking (PR Docket 84-960) that details the implementation of our new allocations. Here's what they've got in mind.

- 30 METERS: Amateurs with a General-class license or above will have 10.100 to 10.150 MHz available for CW or RTTY, with no special power limitation. Effective immediately, the 10.109 to 10.115 "window" no longer exists. Remember, you're still allowed only 200 Watts PEP on this band.
- 17 METERS: Forget about the 18.068–18.168 segment for a while. The FCC says that access to this band will not be available until 1989.
- 12 METERS: Things are a bit brighter for the 24.890 to 24.990 allocation. The National Telecommunications and Information Administration (NTIA) says that shared use of the band by amateurs with government fixed stations would not be a problem. The Commission would like to open this band as soon as possible. Right now, the band plan looks like this: 24.890–24.930 CW/RTTY and 24.930–24.990 CW/SSB. Amateurs with a General or higher license will be allowed to operate on 12 meters, with no special power restrictions.

Remember, these are just proposals—with the exception of 30 meters, you can't use these new frequencies until the FCC issues a final Report and Order. Watch "QRX" for further details.

Megachamp!

OUTRAGEOUS is the word that came to mind when I opened a letter from **John Kanzius K3TUP.** John has won *73*'s 40-meter SSB Championhip for two years running, and he wanted us all to see why. The antenna in the photograph is a KLM 4-element monobander. I don't want to know how high it is! What isn't shown is the rest of the farm: 6 over 6 on 10 and 15 meters, 6 over 5 on 20 meters, a 4-element phased vertical array for 80 meters, and a W1CF quarter-wave sloper on 160 meters! For the curious, John says that the aluminum is .9 wavelengths high for the lower antennas and 2.25 wavelengths up for the rest! Feeding all of this are a pair of Kenwood TS-930Ss, a Rockwell KWM-380, and an Alpha 77D. Any more questions?

220 Vote!

TWO VERY IMPORTANT VOTES are due soon from the FCC. The first involves the **LMCC petition** for additional spectrum in the land-mobile service. The inside scoop is that LMCC will not receive any allocation in the 800-MHz reserve, and that leaves chunks of 220 MHz up for grabs. If this vote goes against amateur radio, it will mean an NPRM aimed at an orderly transition to commercial interests on this band. The other vote concerns the highly-touted **Personal Radio Communication Service (PRCS),** which seemed to be a low-cost alternative to cellular telephone. General Electric, which already has invested millions of dollars in research and development, decided to table their efforts early last week. This clears the way for the Commission to lay PRCS to rest.

Head Ham

RAJIV GANDHI, Prime Minister of India, is also VU2RG! His Excellency is not the only ham in the Gandhi family—**Sonia Gandhi,** Rajiv's spouse, holds VU2SON. How long will it be before we hear a "heads of state" net on 20 meters?

Log Jam

ON THE DX FRONT, there's bad news from Africa. What used to be XT Upper Volta is now **XT Burkina Faso.** The bad news is that the new name doesn't fit the "QTH" column in the logbook! From **Gus Browning's *DX'ers Magazine*** comes word of an expedition to ZA Albania, and the word is, "Don't hold your breath..." According to Gus, several DL stations are trying to gain permission to operate, including DJ0UJ, but chances are less than slim that governmental blessings will be issued. The *DX'ers Magazine* is a good way to stay on top of the changing DX scene, and you can reach Gus at PO Drawer DX, Cordova SC 29039.

K3TUP's monster aluminum.

Packet Draft

A NATIONAL PACKET REGISTRATION PROGRAM is underway through the auspices of the **Central Illinois Packet Radio User Society (CIPRUS).** These folks are trying to create a list of every packet-radio enthusiast in the country. If you are active on this mode, please send the following information to CIPRUS: callsign, name, address, and miscellaneous information (digipeater, mailbox, grid locater, etc.). Mail this, along with a very large SASE, to CIPRUS, PO Box 4143, Peoria IL 61607. This kind of service does not come cheaply. According to **Greg Smith N9AGC,** "...we will not turn down any donations toward paper costs that you would care to make."

Form Fact

A NEW FORM 610 is being passed out by the FCC. It reflects the changes in the testing structure and includes spaces for VE certification. Your local VEC or the FCC can supply you with a copy.

Digital Paper?

THE FOURTH ARRL Radio Computer Networking Conference will be held in San Francisco, California, on March 30, 1985. Technical papers are being solicited on all aspects of amateur digital communications, including packet switching, meteor scatter, and satellite systems. Topics may include network architecture, proposed standards, hardware/software, protocols, modulation and encoding schemes, applications, and practical experience. The deadline for camera-ready manuscripts is March 1, 1985. Papers should be mailed to Marian Anderson WB1FSB, ARRL, 225 Main Street, Newington CT 06111. If you plan to present a paper, you should request an author's kit and identify the title of your proposal as soon as possible.

ICOM, They Go

AFTER READING IN "QRX" that *73* had moved to plush new offices, **ICOM America, Inc.,** decided to do the same. They've built a beautiful new 40,000-square-foot corporate headquarters in Washington State. The new address is: ICOM America, Inc., 2380-116 Avenue NE, Bellevue WA 98004. I've seen a picture—the building looks like a giant IC-02AT lying on its side!

OFF
Communications Specialists TE-64

Food for thought.

Our new Universal Tone Encoder lends it's versatility to all tastes. The menu includes all CTCSS, as well as Burst Tones, Touch Tones, and Test Tones. No counter or test equipment required to set frequency-just dial it in. While traveling, use it on your Amateur transceiver to access tone operated systems, or in your service van to check out your customers repeaters; also, as a piece of test equipment to modulate your Service Monitor or signal generator. It can even operate off an internal nine volt battery, and is available for one day delivery, backed by our one year warranty.

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77.0 XB	100.0 1Z	131.8 3B	173.8 6A
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82.5 YZ	107.2 1B	141.3 4A	186.2 7Z
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Eight Mods for the IC-730

Customize your ICOM! Snip here, solder there, and enjoy perfection.

I have owned my ICOM 730 for over two years now, and I am still continually impressed with the high performance of this fine example of modern technology! However, I am a perfectionist, and I honestly don't think it is very likely that any manufacturer will ever create a rig that would be "perfect" for my tastes. They all seem to overlook one or two things, but they are getting closer all the time!

I have always found that the best way to obtain the perfect ham rig (or anything else) when it is not readily available is to take the closest available thing and adapt it to suit my individual requirements. With that thought in mind, I proceeded to design and install several easy modifications for the IC-730 that I feel have enhanced its "proximity to perfection." I will describe each modification separately to give you the opportunity to consider each on its own merits. You then can determine whether to add any of these enhancements to your own IC-730. None of the modifications is difficult to accomplish, and some are almost no work at all!

Sidetone-Pitch Control

The IC-730 does not include a control to adjust the pitch of the internal CW sidetone oscillator. I consider this an essential feature because in my home station I frequently use narrow active audio filters for enhanced CW reception. If the pitch of the sidetone oscillator in the 730 does not just happen to match the center frequency of any external audio filter you are using, the sidetone will be lost forever in passing through the audio filter, requiring you to switch the filter in and out each time you change between transmit and receive!

An extremely simple modification will allow you to add a convenient sidetone-pitch control that can be adjusted by turning a control inside the hatch cover on the top which allows access to the auxiliary controls. Adjusting this new control will allow you to match the sidetone pitch easily to any external filter you are using.

To create this new sidetone-pitch control, simply remove the fixed resistor, R109, on the main circuit board (refer to the ICOM 730 operating manual) and replace it with a 20k subminiature trimmer. Component spacing is a bit tight, so this will require a very small trimmer.

The new tone-adjust control is not only useful if you are using external audio filters; it is also very convenient to be able to vary the audio pitch to suit individual operator preferences. Changing the pitch from time to time can help reduce operator fatigue during long periods of CW operation.

Improved Sidetone Oscillator

Although the sidetone-pitch control described above does solve the problem of adjusting the sidetone-oscillator pitch, there is another characteristic of the IC-730 sidetone oscillator that bugged me: The stock sidetone-oscillator circuit produces an irritating click on make-and-break during CW keying. This apparently is caused by the clamping action of transistor Q16 in the sidetone circuit.

After several unsuccessful attempts to modify the oscillator circuit to correct this, I came to the conclusion that perhaps the best approach would be to abandon ICOM's oscillator circuit completely and design a new circuit that would produce the desired clean-sounding sidetone with no annoying clicks. To create this circuit, I borrowed on one of my earlier efforts, a code-practice oscillator circuit (see "The Penultimate CPO," *73*, September, 1980), and modified it to be controlled by the ICOM 730 keying circuits.

Fig. 1 is a schematic diagram of the improved sidetone-oscillator circuit. It requires that only four connections be made to the 730. I constructed this audio-oscillator circuit on a small piece of perfboard and installed it under the hatch cover on the rig's top. This location allows you to adjust the circuit's pitch and output volume easily.

The procedure for installing the new oscillator is as follows: First, locate green jumper wire F on the main circuit board and cut it near the end that is near transistor Q16. Tape over the Q16 end and tuck it aside. The

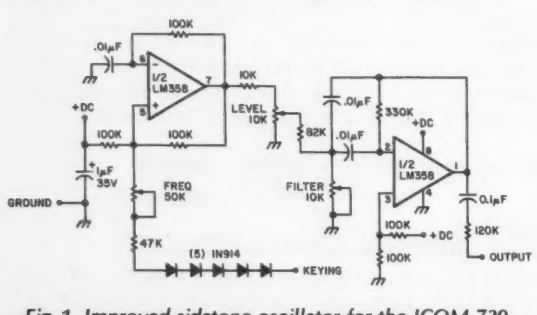

Fig. 1. Improved sidetone oscillator for the ICOM 730.

four connections for the new circuit may now be made:

- The +dc power connection goes to control line CW8, available at pin 4 of J13 on the main circuit board.
- The ground connection goes to SPE, the speaker ground, available at pin 2 of J18 on the main circuit board.
- The keying connection goes to KEY line, available at pin 3 of J18 on the main circuit board.
- The output connection goes to either end of resistor R114 on the main circuit board.

To adjust the new sidetone oscillator, proceed as follows: Key down (dummy load, please!) and adjust the FREQ control to 750 Hz or your preferred pitch. Then adjust the FILTER control to the same frequency by adjusting it for the loudest and clearest-sounding output tone. Last, adjust the LEVEL control for the desired output volume.

Although the improved sidetone-oscillator circuit is a bit more work than the other modifications in this article, I'm sure that if CW operation is one of your main interests, you will agree that the beautiful clean-keyed sine wave that this oscillator circuit produces is worth the extra work!

Improved CW-Filter Switching

When both the FL-45 CW crystal filter (500 Hz) and the EX-203 active audio filter options are installed, the stock filter-switching arrangement that ICOM designed seems backwards: It works out so that when you are in either CW mode (CW or CW-n, the narrow position), the 150-Hz-wide EX-203 audio filter is switched in, but the 500-Hz-wide FL-45 filter is switched in only in the CW-n position.

If you stop and think about this, I'm quite sure you will agree that it doesn't seem to make much sense to leave a 150-Hz-wide filter in the circuit and switch a 500-Hz filter in and out; the exact opposite makes much more sense: Leave the 500-Hz filter in the circuit in both CW mode positions and add the 150-Hz active audio filter into the circuit only in the narrow CW position.

Fortunately, the 730 is "cold switched." This means that rather than actually rerouting signals directly through front-panel switch contacts, most 730 panel switches actually switch a dc control voltage which controls signal routing on the boards. To rewire the 730 to allow for the improved CW-filter switching, proceed as follows:

- Remove the green wire from pin 1 of plug P-1 which "hangs" off the EX-203 filter board and carefully fish it out of the short cable into which it is harnessed. Let this green wire hang free for now, and mount the EX-203 as per ICOM installation instructions.
- Locate the two wires, green and blue, coming from P-6, plugged into J4 on the second i-f board. Cut both these wires at the point where they pass behind the center of the S-meter. The short end of the blue wire may be taped at the end and discarded. (Tuck into nearby wiring.) The short green wire should be connected via a length of insulated wire (preferably green) to the green wire which you pulled out. Tape over all connections to prevent possible shorts.
- Two wires are left to connect: the long blue and the long green. Splice the long green to the white wire coming from pin 1 of J1 on the detector board.
- Splice the long blue to the red wire coming from pin 4 of J1 on the detector board. Again, tape over all spliced connections.

Improved Audio-Filter Operation

My EX-203 active audio CW filter, as supplied, rings and adds audio distortion. To tame it down, I replaced both resistors R2 and R9 (originally 560k) with 270k resistors. This cleaned things up nicely and provided nearly equal audio-output level from a centered signal whether the filter is switched in or out.

After the resistors have been changed, re-peak the two filter stages by adjusting R7 and R14 trimmer potentiometers on the EX-203 board for maximum output with a 750-Hz audio note, with the rig in the narrow CW mode and a medium-strength carrier received.

I believe that optimum adjustment of an audio filter is somewhat a matter of individual taste. If you wish to experiment with the characteristics of the EX-203 audio filter, you will find that (1) overall gain can be adjusted by changing the value of resistors R1 and R8, (2) bandwidth can be adjusted by changing the value of resistors R2 and R9, and (3) center frequency may be adjusted by varying the value of resistors R7 and R14. All these values interact somewhat, so you may have to play with resistor values awhile to get exactly the characteristics you prefer.

Panel-Lamp Brilliance

The panel-meter illumination from the S-meter on the 730 is very bright, and I found that to be distracting during mobile operation. It was so bright that it made me squint when I looked at it, and it seemed to disturb my night vision. Fortunately, there is an extremely simple fix for this problem: Simply break the path of the source wire that feeds dc to the S-meter lamp and insert a 24-Ohm, 1/2-Watt resistor in series with it. Tape over any exposed connections to avoid potential shorts later.

The S-meter lamp will now glow a mellow yellow color, much dimmer than the stock configuration but still plenty bright enough to read the meter very easily. A bonus is the much-prolonged bulb life you may now expect due to the lower bulb current.

Auto Memory Hold

The 730 has two vfo frequency memories plus a memory for each band. Unfortunately, whenever you turn the power off, all memories are lost. During mobile operation, this means that if you turn the rig off when you leave the car, you will have to reprogram all the memories when you return. A simple modification will allow the 730 to keep its memories alive even when the rig's power switch is off, so long as the rig remains connected to a source of +12-volt-dc power. To implement this change, proceed as follows:

- Remove the red wire plugged into jack J8 on the logic unit.
- Cut the plug off this red wire and set it aside. Tape over the end of the red wire so that it cannot short to anything and hide it away in a group of nearby wires.
- Solder a 10-inch wire to the top-rear terminal of the power switch. Route this wire along any convenient cable bundle to jack J8 on the logic unit.
- Solder the plug that was cut from the red wire to the free end of the new power-switch wire (discarding any excess length) and plug it into J8 on the logic unit.

Both vfo frequencies and all band memories will now be held in memory as long as dc power remains supplied to the rig's main power connector. Current drain when the rig is turned off will be about 18 mA—not a significant drain on your car battery, and a small price to pay to avoid the nuisance of having to reprogram memories every time you return to your car!

This modification comes

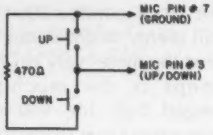

Fig. 2. Adding up/down tuning to the ICOM 730.

with a free bonus: The memory jack on the rear of the rig now connects to nothing, so you may feel free to use it for any desired spare function via the taped red wire that was cut from the J8 plug.

Up/Down-Tuning Microphone

I must admit it: I have tried ICOM's own optional up/down-tuning mobile microphone for the 730 and I didn't like it for two important reasons. First, it has a very uncomfortable box shape, the feel of which I did not care for, and second, the push-buttons are too hard to push—and especially to hold down for the prolonged period of time required to scan across a band.

I solved this problem by carefully removing the microphone cartridge and preamplifier from the handheld microphone supplied and carefully repackaging them into a microphone I liked better (that had the necessary push-buttons for up/down tuning). This preserved the exact audio characteristics of the original stock microphone yet allowed for up/down tuning from the microphone—a great convenience for mobile operation.

The up/down-tuning function is actually already implemented in the 730. To use it, you must wire up your microphone switches as shown in Fig. 2, adding a 470-Ohm resistor for up/down control.

Cooling-Fan Control

The 730's cooling-fan circuit has two modes of operation. First, the fan runs at low speed at all times when in the transmit mode (push-to-talk operated, key down, or transmit switch depressed). Second, high-speed fan operation occurs when the heat-sink temperature exceeds approximately 75 degrees Celsius, a condition which triggers a thermal switch, causing the fan to run at high speed during both transmit and receive until the heat sink cools back down.

There really are times, however, when it is not necessary to have the fan running at all, such as during periods of QRP operation or whenever the transmit power or duty cycle is low. A switch can be installed that will allow you to bypass the fan in its low-speed mode. This will save battery power, eliminate unnecessary fan noise, and prolong fan life.

To provide a switch selection of fan operation on transmit but still leave the emergency mode of fan operation on overheat, simply lift one end of resistor R24 on the power-amplifier board and insert an SPST switch in series. A common mini-toggle switch will fit perfectly in the hole left in the rear-chassis panel if J5 (the memory backup jack) is removed. (This jack is not used anyway if you have done the Auto Memory Hold modification in this article.) My new switch is labeled "Fan Normal/QRP."

All of the modifications described in this article have been in my 730 for at least one year now, with absolutely no ill effects observed. I feel that they have significantly enhanced the capabilities of my mobile and CW operations. I hope you will find some of them to be useful improvements to your own 730 operations. Perhaps they will even help you get a step or two closer to having your own ultimately perfect rig for your own style of operation. ■

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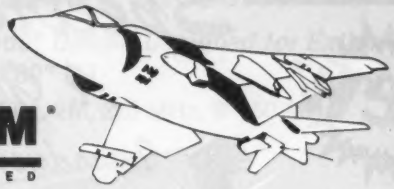

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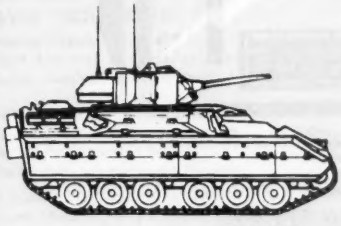

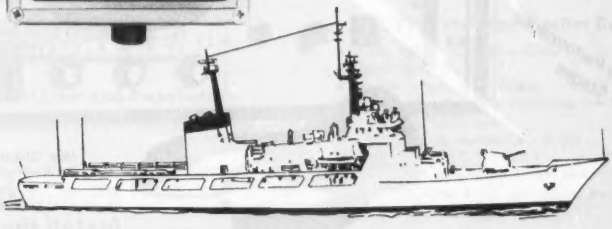

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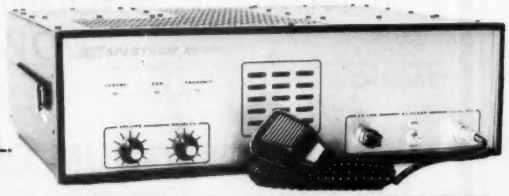

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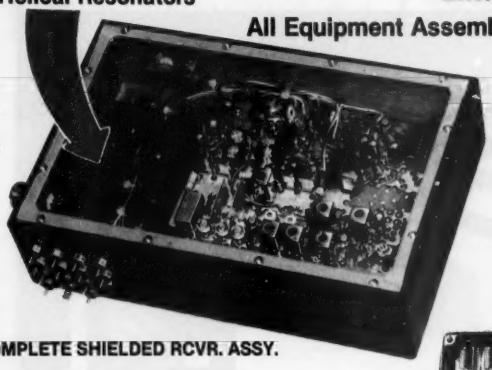

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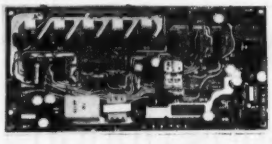

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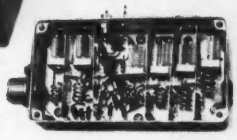

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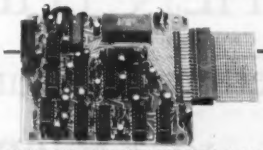

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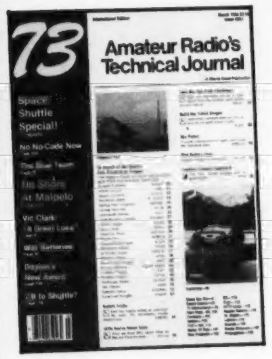

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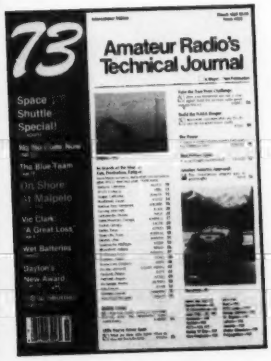

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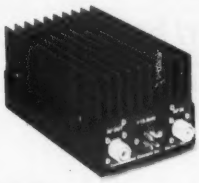

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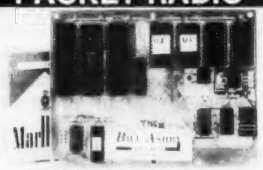

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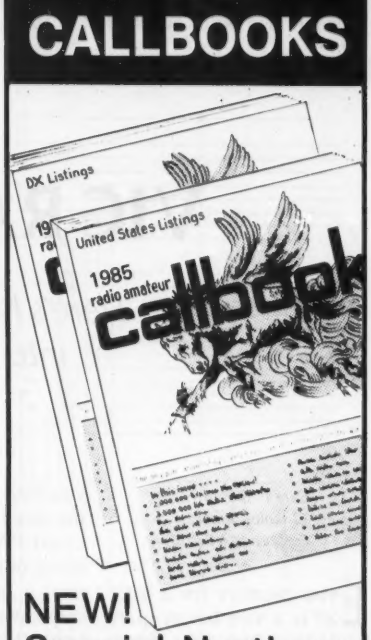

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VIC RAMification: Part I

Here's how to turn 3 ICs and half an hour into 24K of extra VIC-20 memory.

Gary P. Brefini
12 Bailey Street
Foxboro MA 02035

Extra memory for a VIC-20 is a nice luxury, particularly when you have just finished editing a program but find that there are not quite enough memory locations for those DIM statements. This happened to me recently while preparing a VIC-20 Basic program to design yagi antennas. The solution is, naturally, more memory. But how? This article will show you how to completely fill the three 8K blocks of allocated RAM for the VIC-20 using only 3 ICs, 3 capacitors, a mother board, and some wire. Your construction effort will be worth it when your video monitor, after power-up, reads: "28159 BYTES FREE."

The *VIC-20 Programmer's Reference Guide*[1] explains the memory map for the VIC-20, so I will not go into detail about it. However, the VIC does have two areas in which to add additional memory: a 3K space from addresses $0400 to $0FFF and a 24K section from addresses $2000 to $7FFF. When the 24K expansion area is used, Basic cannot reside in the smaller 3K area. The memory expansion project in this article is designed to fill the larger 24K area.

The 24K area is composed of three contiguous 8K blocks. Block #1 resides in locations $2000 to $3FFF, block #2 resides in locations $4000 to $5FFF, and block #3 is located in memory at $6000 to $7FFF. Filling these locations gives the Basic programmer an additional 24K of usable Basic on top of the factory-installed memory of the VIC-20, which is 5K bytes. When the 24K memory is installed, the VIC's kernel program readjusts locations of various housekeeping routines, such as the screen buffer, so that a large contiguous area of available RAM is dedicated to the programmer.

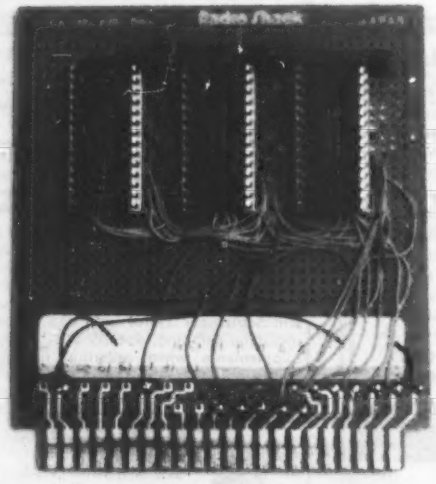

Photo A. Top view of the completed memory-expansion board.

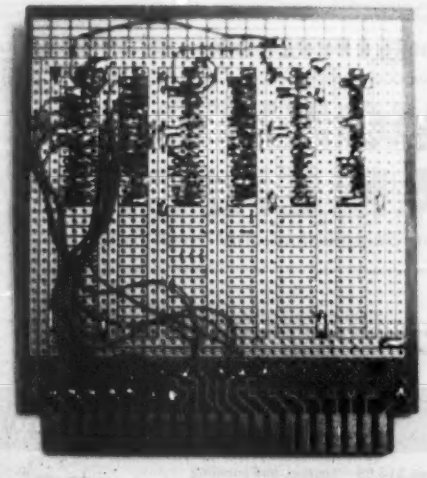

Photo B. Underneath the memory board. Point-to-point soldering was used in lieu of wire-wrapping.

Board Design

Any memory expansion for the VIC must be done via the 22/44-pin expansion port at the right rear of the keyboard case. This connector is an industry standard card-edge connection, so locating a mother board is no problem. I chose the Radio Shack 276-154A board. This is a 3-voltage-source plug-in board with a 22/24-pin card-edge connector.

The next step was the selection of the actual ICs to be used for the memory. I had previously built a 3K expander using 2114 RAM chips. These RAM chips are 4K-bit devices arranged as 1K of half bytes or nibbles. Each 1K byte of memory requires a pair of 2114s. It was a lot of point-to-point wiring for that 3K board. Granted, it was fun and only took 3 hours to build, but a 24K RAM board constructed out of 2114s would need 48 ICs! So I decided to look around at available high-density static RAM chips. I found that Hitachi makes a 64K-bit device (HM6264) arranged as 8K by 8 bytes. Perfect! All that is required is 3 of these beauties and my VIC would be fully populated with memory.

Fig. 1 shows the schematic for the 24K-byte RAM board that plugs directly into the expansion port. Using the HM6264 RAMs makes the interfacing to the port simple, since no additional bus buffering is required. That's due to the on-chip tri-state buffers and the fact that each chip can be selected by lines already available at the VIC's port without decoding logic. Each chip draws only 40 milliamps, which is no problem for the VIC's built-in power supply.

The circuit is fairly straightforward. Each HM6264 IC has the address, data, and write-enable lines tied in parallel. Only the chip-select lines are uniquely connected to the card-edge connector. Note that there are two chip-select lines on each HM6264. Pin 20 is the inverted chip select and pin 26 is the non-inverted chip select.

Pin 26 is used if one desires a power-down operation. If not, pin 26 should be tied high to +5 volts. I chose the latter option. This leaves the inverted chip-select line, pin 20, of each HM6264 to be tied individu-

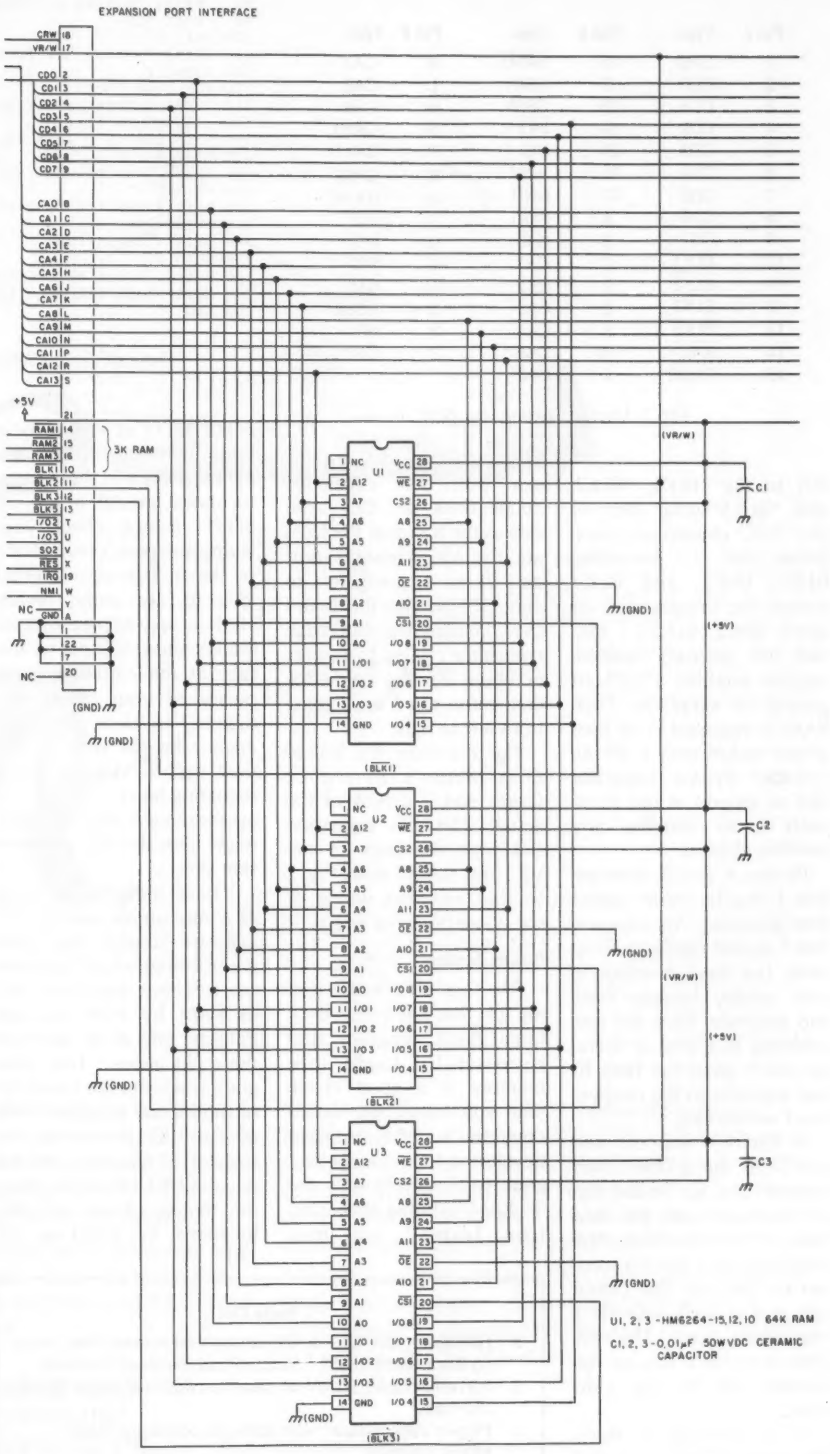

Fig. 1. Schematic of 24K RAM circuit.

Pin #	Type	Pin #	Type	Pin #	Type
1	GND	16	RAM3	K	CA7
2	CD0	17	VRW	L	CA8
3	CD1	18	CRW	M	CA9
4	CD2	19	IRQ	N	CA10
5	CD3	20	NC	P	CA11
6	CD4	21	+5V	R	CA12
7	CD5	22	GND	S	CA13
8	CD6	A	GND	T	I/02
9	CD7	B	CA0	U	I/03
10	BLK1	C	CA1	V	S02
11	BLK2	D	CA2	W	NMI
12	BLK3	E	CA3	X	RESET
13	BLK5	F	CA4	Y	NC
14	RAM1	H	CA5	Z	GND
15	RAM2	J	CA6		

Fig. 2. Memory-expansion port.

```
10 REM: 24K MEMORY DIAGNOSTIC ROUTINE
20 REM: G.P. BREFINI JUNE 1984
30 PRINT "■"
40 PRINT "INPUT START ADDRESS IN ";"DECIMAL?": INPUT A1
50 PRINT " ": PRINT "INPUT END ADDRESS IN ";
60 PRINT "DECIMAL?": INPUT A2
70 FOR I=A1 TO A2
80   PRINT "POKING AT MEMORY ADD# ";"        ";I
90   POKE I,0
100 NEXT I
110 PRINT ">>>>>> END POKE <<<<<<"
120 SUM=0.0
130 FOR I=A1 TO A2
140   PRINT "PEEKING AT MEMORY ADD#";"        ";I
150   SUM=SUM+PEEK(I)
160   IF SUM <> 0 THEN 240
170 NEXT I
180 PRINT "CHECK SUM=";SUM
190 PRINT " "
200 PRINT "CHECKED ";A2-A1;"BYTES"
210 PRINT "OUT OF:"
220 PRINT "BYTES FREE "; FRE(0)
230 GOTO 260
240 PRINT "ERROR AT LOCATION #   ";I
250 PRINT ">>> CHECKSUM ERROR <<<"
260 END
```

Program listing. Memory diagnostic routine.

ally to the *BLK1, *BLK2, and *BLK3 signal lines of the VIC expansion port. (Note: the "*" preceding BLK1, BLK2, and BLK3 means the complement of BLK1, BLK2, BLK3.) I also tied the normally-inverted-output enables (*OE) to ground for simplicity. Each RAM is mounted in its own 28-pin socket with a .01-microfarad bypass capacitor tied to ground at pin 28 of each IC to eliminate any possible glitches.

Photos A and B illustrate that I like to solder rather than wire-wrap. My reason is that I do not own wire-wrap tools, but have a soldering iron, solder, hookup wire, and patience. Plus, for me, soldering is a kind of therapy which gives me time to pay attention to the connection I am making.

In Photo A you can see that I ran the address lines between the ICs at the top of the board and the data lines at the mid-portion. The data lines from the ICs were run on the top side (same side as ICs) along with the 3 chip-select lines. The address lines were run on the bottom side to the card edge.

It is important to study the sense of how the board plugs into the VIC's expansion port. The card-edge connections on the same side as the ICs (as in Photo A) are the VIC expansion-port pins 22 to 1, going left to right. If you flip the board over, keeping the card-edge connector closest to you (as in Photo B), the card-edge connectors run A to Z, going from left to right.

Fig. 2 is from the *VIC-20 Programmer's Reference Guide* and is a view of the actual 22/44-pin expansion slot from the back of the VIC. You should study Fig. 2 so that incorrect wiring of the board does not occur.

Board Testing

The final step is the testing of the RAM board. A large Basic program that successfully loads into memory is a good check that you wired the board correctly. You may not have developed such a large program working with only the 5K RAM installed at the factory. Instead, you may POKE $FFFF at several locations between $2000 and $7FFF. A PEEK at these same locations should return an $FFFF. If not, check your wiring for poor connections or shorts. It is also a good idea to use some emery cloth or very fine sandpaper (an ink eraser will do) on the tabs at the card-edge connector of your board. Remember to clean the card-edge contacts with a solvent, such as video or audio recording-head cleaner, to avoid foreign deposits that might jam the VIC's expansion slot.

I have included a listing of a very simple memory diagnostic routine (see program listing) which you can use to check your new 24K of RAM by POKEing and PEEKing into all or some of these locations. This program resides in the lower 5K of the factory-installed RAM of the VIC. If you let A1 equal 8192 (decimal) and A2 equal 32767 (decimal), then the routine checks all 24K locations by POKEing all zeros, then PEEKing and forming an all-zero checksum if the memory is operating correctly. It takes about a half-hour to check all 24K locations. You could just check a few sub-blocks over the 24K range if you are in a hurry.

The hardest task in building this board was in orienting the connections of the address lines and data lines on the board to the VIC's expansion-port signals. In addition, the HM6264 is a relatively new static RAM chip, and it is not as available as is the 2114. But as we all know, this situation will improve as time goes by. I have listed some suggested part sources along with a parts list at the end of this article.

Building this 24K RAM board will be a rewarding experience, especially when you need that extra memory! Good luck.■

Parts List

- 3 HM6264P (150-, 120-, or 100-nanosecond access time), Jameco Electronics, 1355 Shoreway Road, Belmont CA 94002.
- 3 0.01-microfarad, 50-WV dc ceramic capacitor, Radio Shack 272-1065.
- 1 Plug-in Vectorboard® with 22/44-pin connector, Radio Shack 276-154A.

References

1. A. Finkel, N. Harris, P. Higginbottom, M. Tomczyk, *VIC-20 Programmer's Reference Guide*, Commodore Business Machines, Inc., and Howard W. Sams and Co., Inc., First Edition, 1982, pp. 124–125.

2. Joel Swank, "The Enhanced VIC-20; Part 2: Adding a 3K-Byte Memory Board," *Byte*, March, 1983.

3. Hitachi *IC Memory Data Book*, #M10, available from Hitachi America, Ltd., 1800 Bering Drive, San Jose CA 95112.

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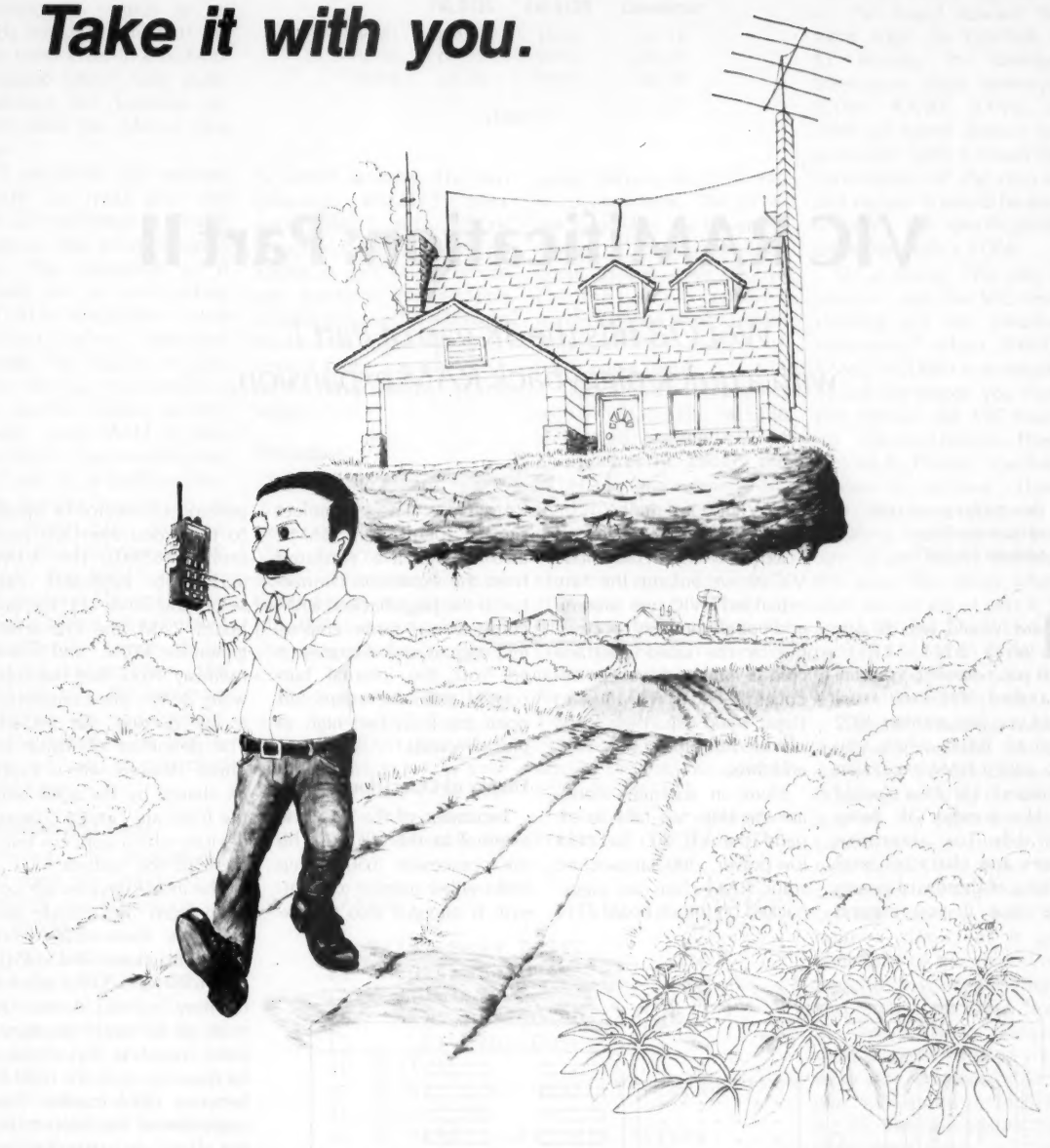

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VIC RAMification: Part II

W6LOB fills the 3K gap of Part I with a quick piggyback RAM expansion.

John T. Cocking W6LOB
18812 Aspesi Drive
Saratoga CA 95070

How would like to see "6655 BYTES FREE" when you power up your unexpanded VIC-20? How would you like another 3072 bytes of Basic when you have added RAM expansion cartridges? Or how would you like another 3K bytes available for alternate screens and character sets? All three of these wishes can come true if you expand your VIC-20 internally.

By adding 3072 bytes of static RAM inside the VIC-20, we enlarge the "unexpanded" VIC, we provide additional memory accessible by the video interface chip (6560), and we can recover the 3K of RAM lost to Basic when expansion RAM is added to blocks one, two, and three.

Here, in summary form, are the steps we take to expand the VIC-20: Six 2114 low-power, 300-nanosecond static RAM chips are piggybacked on the on-board 2114 RAM chips. The chip-select signals for RAM1, RAM2, and RAM3 are rerouted from the expansion connector to the piggybacked RAM chips. These same chip-select signals are disconnected from the internal bus-control gate; the inputs left open are then tied high to plus five volts.

Theory of Operation

Expansion of the VIC-20 is external to the VIC-20. The microprocessor (6502) chip looks either outside to whatever is plugged into the expansion connector or inside to the video interface controller (6560), the VIAs (6522s) for keyboard, cassette, and other I/O, the on-board RAM, the character-generator ROM, and color memory. Note that the software ROMs are considered to be outside the VIC-20. The definition of inside is: Those devices which must be shared by the 6502 and the 6560 are "inside," those devices which concern only the 6502 are "outside."

The inside devices are isolated from the outside devices by three-state octal bus transceivers (74LS245s). The 6560 is a DMA (direct memory access) device. It must get at screen memory, color memory, and character memory while the 6502 is between clock cycles. The operation of the 6560 must not affect any expansion device. Similarly, any access the 6502 makes to an external device must not affect internal devices. In addition, the 6502 must be able to access internal devices (RAM, character memory, color memory) without causing bus contention, a fancy label for a data traffic jam. The bus transceiver is controlled by a 13-input NAND gate (74LS133). When the 6502 looks for external devices, address decoding delivers a low signal on one of

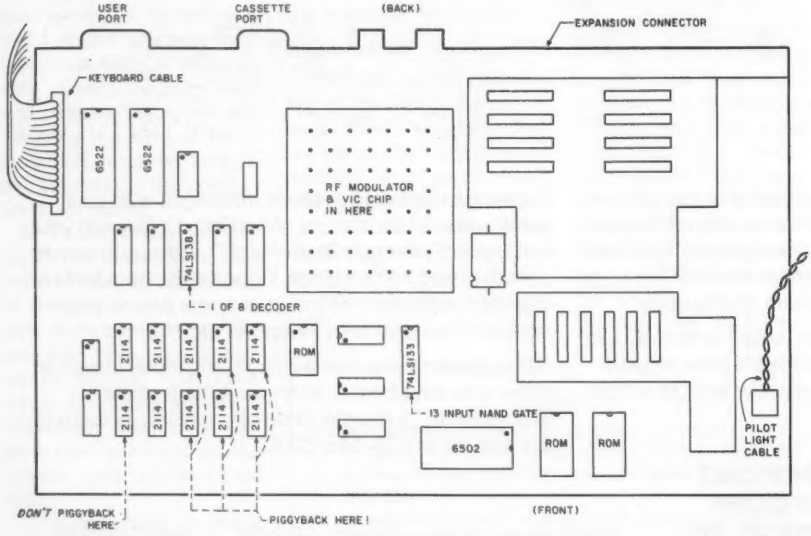

Fig. 1. Inside the VIC-20. Piggyback your new memory only where shown.

the 13 inputs to the 74LS133, causing its output to go high, which in turn puts the bus transceiver in a high-impedance (don't care) state, isolating the internal devices from the external data bus.

If we are to add memory inside, we must alter the VIC-20's definition of what is internal and what is external. The definition as it stands in an unmodified VIC-20 is: Any device whose address when decoded causes the 74LS133 to disable the bus transceiver is an external device. RAM1, RAM2, and RAM3 fit this definition. Our modification will add 3K of RAM as internal devices connected to the inside data bus. We must also redefine RAM1, RAM2, and RAM3 as internal devices. This means removing these signals from the expansion connector, removing them from the 74LS133, tying the now empty inputs high, and connecting the signals to the chip selects of our piggybacked RAM chips.

Materials and Tools

Here is a list of materials and tools we will need to perform our expansion of the VIC-20:

1) Six low-power, 300-ns 2114 static RAMS—JDR Microdevices, 1224 S. Bascom Avenue, San Jose CA 95128 carries the 2114L-3 at 8 for $13.45.

2) Wire-wrap wire.

3) Low-power soldering iron (30 Watts).

4) Extra-thin resin-core solder.

5) X-acto® knife with #11 blade.

6) Phillips screwdriver (to open up the VIC).

7) Volt-ohmmeter for continuity testing.

8) "Third-hand" vise.

In addition to the "hardware" items, there is also the software. We need a RAM test program, an alternate program load-address procedure, and a program to move the screen to our newly added memory. The two programs, RAMTEST (Program listing 1) and SCRMOV (Program listing 2) should be keyed in and saved before any hardware modification is undertaken. The alternate load-address procedure is executed in direct mode: POKE 43,1: POKE 44,16: POKE 4096,0: CLR.

	74LS138	74LS133	Expansion Connector
RAM1	pin 14	pin 4	pin 14
RAM2	pin 13	pin 5	pin 15
RAM3	pin 12	pin 6	pin 16

Table 1.

Procedure

1) Open up the VIC. There are three Phillips screws under the front edge of the VIC. Remove these and gently lift the front. The case is hinged at the back. Unplug the keyboard cable and the power-indicator lamp cord.

2) Locate the 2114s. You may have a VIC that uses 2K-by-8-bit RAM chips. If so, you will have to follow a different procedure. The procedure for both types of RAM chip is essentially the same, but only the 2114 chip is covered here. The 2114s are located in the lower-left corner of the board. They occur in two rows of five columns. Each column makes up one K of random access memory, so five columns equal five K.

3) Locate the chip-select gate (74LS138). The 74LS138 is located on the row of chips directly above the 2114s, in the upper row, third from the left. This chip is used as an address decoder and it provides chip-select signals (low) for each 1024-byte piece in the first 8192-byte block, which we could call BLK0. We are interested in the select lines for RAM1, RAM2, and RAM3. These signals travel to the expansion connector and also to the data-bus control chip, the 74LS133.

4) Locate the data-bus controller (74LS133). This chip is located in the middle of the board toward the front edge. Its function is to "tri-state" the data-bus transceiver chips whenever RAM1, RAM2, RAM3, or other off-board devices are accessed. Table 1 shows the connections of the chip-select signals. It would be wise to verify the specifications presented with a VOM.

5) Cut traces. This step is taken to stop the VIC from shutting off the data-bus transceiver when RAM1, RAM2, or RAM3 is accessed. To cut the traces, you must first remove the VIC board from the case bottom. There are eight Phillips machine screws to remove. There also may be a sheet of rf shielding taped to the bottom of the board. Remove this also. The traces which must be cut are at pins 4, 5, and 6 of the 74LS133 and pins 14, 15, and 16 at the expansion connector. Use the X-acto knife for this task.

Warning: When you turned the board over, the relative position of the pins changed. What was once on the left is now on the right. Be extra careful you are cutting the right traces. Also, make two cuts very close together and pry out the tiny chunk of copper—don't let it get under any of the chips. Wet the end of your little finger and remove the scrap from the board. Now, using a short piece of stripped wire-wrap wire, connect 74LS133 pins 4, 5, and 6 to 74LS133 pin 15. This will ensure that these three inputs will stay high (tied to plus five volts). Verify these new connections (and disconnections) with the VOM.

6) Install 2114s. This step takes the most time. We are going to piggyback six new 2114 RAM chips on top of six of the on-board 2114s. Whatever you do, do *not* use the left-most column of on-board 2114s for piggybacking. This is the lowest 1K block of RAM which is used by the operating system and the 6502 chip itself.

```
RAMTEST

10 PRINT "RAM TEST"
12 A=1024: B=4095
14 FOR I=A TO B
16      PV=85: GOSUB 24
18      PV=170: GOSUB 24
20 NEXT I
22 PRINT "TEST COMPLETE": END
24 POKE I,PV
26 IF PEEK(I)=PV THEN RETURN
28 PRINT "ERROR AT ADDR.";I
30 PRINT "DATA IS"; PEEK(I)
32 PRINT "SHOULD BE";PV
34 RETURN
```

Program listing 1.

```
SCRMOV

10 POKE 36869,144
12 POKE 648,4
14 FOR J=217 TO 228: POKE J,132: NEXT J
16 FOR J=229 TO 250: POKE J,133: NEXT J
18 POKE 43,0: POKE 44,6: POKE 1535,0
20 CLR:NEW
```

Program listing 2.

This area includes "page zero" and the processor stack in page one.

Use the middle three columns for piggybacking the new RAMs. Make sure that all the pins on the new 2114s are parallel. Test fit them on the on-board RAMs. The new chips should fit snugly without forcing. Now locate the chip select (pin 8) on each of the new 2114s and bend it outward until it is parallel to the circuit board. Put each chip into the third-hand vise and lightly tin the inside of each of the pins. Place the six new 2114s piggyback on the middle six on-board RAM chips.

Leave some breathing room between the on-board chip and its piggyback partner. Be sure you have oriented the new chips correctly. Pin 1 on these chips is generally indicated by a little dimple on the top of the chip. Pin 1 should be at the upper-left corner. Now, it is time to solder on the new chips. Tack-solder each to pins 1 and 10. Pin 10 is diagonally opposite pin 1. After each chip has been tacked on, briefly touch each pin's junction with the soldering iron. Check continuity of pin 1 of the new chip to pin 1 of an on-board chip without a piggyback partner. Do this for each pin with the exception of chip-select pin 8. Note any pins showing an open circuit. Use the tip of the X-acto knife to gently push and hold the pin while applying the soldering iron. Retest while applying the soldering iron. Retest the continuity with your VOM.

7) Prepare the chip-select lines which will connect each column (three of them) to one of the chip-select outputs of the 74LS138. The lines are made of three-inch lengths of wire-wrap wire. Strip one inch off one end and 1/8 inch off the other end. Tin the short end. The long end is connected to the chip-select pins, which are sticking out of the piggybacked RAM chips. Make a very small loop in the long stripped end right next to the insulation and slip it on the chip-select pin of the 2114 in the top row. Then, loop a turn around the chip-select pin of the 2114 directly below in the column. Solder the two connections. Now solder the short stripped-and-tinned end to pin 14 of the 74LS138. This column is now RAM1. Repeat for the next column, connecting its chip-select line to pin 13 of the 74LS138. This column becomes RAM2. The last column is connected to pin 12 of the 74LS138 and becomes RAM3. Check the continuity of these connections with the VOM. Now make a non-continuity check to ensure that the RAM1, RAM2, and RAM3 select lines are *not* connected to pins 4, 5, and 6, respectively, of the 74LS133.

8) This completes the hardware modifications. Before you put your VIC-20 back together and plug it in, here are some items you should check very carefully: First, are there any loose chunks of solder or bare wire lying around on the board? Second, are there any solder bridges between pins on the piggybacked RAM chips? The third point may sound silly. It isn't. I installed one of my 2114s backward. I found out during testing. So, be sure your 2114s are all pointing north. After your work passes this visual inspection, reinstall the board in the case bottom.

9) Button up the VIC. Tape the shield back. Be sure it is oriented correctly. Fasten the circuit board to the case bottom. Do not get the screws for mounting the board mixed up with those for fastening the case bottom to the case top (keyboard). Hinge-in the case top and connect the keyboard plug on the left and the power-on light plug on the right. For initial testing, you may want to leave the case top free or even off to the side a little. For final assembly, fasten the case top to the bottom with the three long screws.

Testing

For the initial "blue smoke" test, keep the expansion slot empty. Turn on the VIC. You should see "6655 BYTES FREE." If you do not, turn off the VIC immediately, reread the procedure, then open up the VIC again and check out each step, using the VOM where necessary. If you received the same old "3583 BYTES FREE," then the VIC is not aware of the RAM that has been added. The chip-select signals for RAM1, RAM2, and RAM3 may still be disabling the internal data bus. Verify that these signals are not connected to the 74LS133 and also that the RAM1, RAM2, and RAM3 inputs to the 74LS133 are connected to +5 V.

If you get nothing on your screen, then perhaps one of your 2114s is installed backwards. This has happened to me. I discovered my mistake by using my finger to see if any of the piggybacked chips were hotter than normal. One of them was very hot, and that is how I discovered the error. I replaced the backwards chip, correcting the malfunction. I learned two things from my error. First, it is necessary to check and double-check work of this kind. Second, the VIC-20 is quite sturdy; you don't have to be afraid of modifying your VIC.

Assuming that you now have received the power-up message of "6655 BYTES FREE," you should run a memory test on locations 0400h through 04FFFh. The RAMTEST program in Program listing 1 will serve, although if you have a better one, use it. To test the memory which you have just added, execute the alternate load-address procedure in direct mode, then load and run the RAMTEST program. The RAMTEST provided executes in approximately sixty-five seconds. Run the memory test more than once. If the test fails, the bad address will be displayed on the screen. From the address you can determine whether RAM1, RAM2, or RAM3 is bad. The display of the data at the failure point enables you to locate the malfunctioning chip. The failure is probably caused by an address line or a data line. Check out the connections to the chip which caused the memory-test failure. Also, check the chip-select line. Only after you have verified that all the connections are sound should you consider replacing the chip.

Moving the Screen

Here is where we recover the "lost" 3K of memory. Power down the VIC, plug in your memory expansion, power back up, and note the "BYTES FREE" message. In my case, it read "28159 BYTES FREE." Now load and run the SCRMOV program (Program listing 2). Clear the screen and execute ?FRE(0) in direct mode. My VIC-20 responded with 31230, which is 3071 bytes more than the power-up message. You should see a comparable increase in available memory. This added memory, unlike a plug-in 3K expansion, may also be used for alternate screens. One final warning: There are many programs which do *not* run with memory expansion. For these programs, you must execute the alternate load-address procedure before you load and run the program. ■

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Nick Hampshire, *VIC Revealed*, Hayden Book Company, 1982.

A. Finkel, N. Harris, P. Higginbottom, and M. Tomczyk, *VIC-20 Programmer's Reference Guide*, Commodore Business Machines, Inc., and Howard W. Sams and Co., Inc., 1982.

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Transistors: A Biased Approach

In Part II, we evaluate base current and gain and use this information to design a working transistor circuit.

Bob Myers KC0EW
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In Part I of this look at transistors, we covered some of the basics of how bipolar transistors behave and went through a simple analysis using only the fact that the base-to-emitter voltage drop is fairly constant. To wrap up this look at basic transistor operation, we now need to consider the effects of base current and beta on our calculations. Remember the two fundamental facts we discussed last time: first, that the drop from the base to emitter is constant (at about 0.7 V for a silicon transistor), and second, that the collector current is some multiple of the base current. The number that you multiply the base current by to figure the collector current is called beta (sometimes written as just the Greek letter, β), and that's what this article is all about.

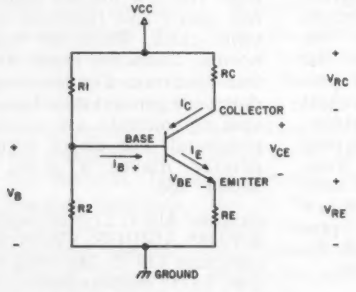

Fig. 1. An NPN transistor in a biasing network. Base, collector, and emitter currents (Ib, Ic, and Ie, respectively) are indicated by arrows. Voltages at the base (Vb), across the collector resistor (Vrc), the emitter resistor (Vre), and from collector to emitter (Vce) are also indicated.

Let's look again at the basic NPN transistor in a biasing network, just like we started the last time (Fig. 1). The arrows in this diagram represent the currents in each of the three leads of the transistor and show the directions in which we normally consider these currents to be flowing. (Note that the arrow on the emitter of the NPN symbol is pointing in the same direction as the emitter current—an easy way to remember it.) We still want to be able to set the collector voltage and current to some set of desired values, i.e., to "properly bias the transistor to a given dc operating point." Last time, we ignored beta and the base current and simply used the voltages around the circuit and the base-emitter drop to figure all the currents. But now, the situation gets a little more complicated. The emitter current is not the same as the base current—both the base and collector currents are shown flowing *in* to the transistor, and the emitter current is flowing *out*. The emitter current is the sum of the base and collector currents. So, if the collector current is beta times the base current, the emitter current must be "beta + 1" times the base current. Knowing the emitter current (and the drop across the emitter resistor) won't do a thing for us as far as getting the collector voltage and current unless we know beta.

Well, that seems like a simple enough problem. All we have to do is look at the spec sheet for the transistor we're using, plug the number for beta into our calculations, and we're done. Well, right now I'm looking at a spec sheet for the ever-popular 2N2222A, a typical general-purpose small-signal transistor. The beta for this part can be anywhere from 100 to 300—a 3-to-1 range! And not only could you expect a variation from part to part, but the beta of a given part will change with temperature, frequency, and a number of other conditions including, of all things, collector current! We're not going to be able to simply plug a number in and go—we don't know the number.

What we'll have to do is to figure out the real effect of beta and then work out some way to keep our design going for any beta within the possible range. Otherwise, a design that works with one part might not work with the next, or might not even work from day to day.

We'll work on figuring out the collector current as a function of the base voltage *and* beta. Once we have the collector current, the collector voltage is easy (it's just the supply voltage minus the drop across the collector resistor). Notice that this ignores any dc load on the collector other than the collector resistor—OK if we're accoupled to the next stage, but keep this in mind.

Well, even if the relation isn't as simple as it used to be, finding the emitter current and voltage will give us something. With the emitter current equal to "beta +1" times the base current, and the collector current simply beta times the base current, we could say that these two currents are related as Ic = $\beta/(\beta + 1) \times$ Ie. The emitter current, thanks to Ohm's Law, still has to be the emitter voltage divided by the emitter resistance, or Ie = Ve/Re. We know the relation between collector and emitter currents, so we can write Ic = $\beta/(\beta + 1) \times$ (Ve/Re).

Aha! Looks like we now need to bring in our other piece of information—that the emitter voltage is 0.7 volts less than the base voltage. Doing this, we write Ic = $\beta/(\beta + 1) \times$ ((Vb − 0.7)/Re).* Whether it looks like it or not, we're a lot closer now to our goal. If we can get Vb in terms of the supply voltage and R1 and R2, we're done. But R1 and R2 *aren't* the simple divider they were last time—not all the current through R1 is making it to R2 since the base is taking some.

This complicates matters somewhat, but don't give up. We can simplify the situation by replacing the circuit to the left of the base (Vcc, R1, and R2) with an equivalent, as shown in Fig. 2. Here, Vth is the voltage that would have been produced by the R1-R2 divider if the base current hadn't been there. Rth is simply the parallel combination of R1 and R2. The "th" modifier comes from the fact that this is what's called a "Thevenin equivalent" circuit, named for the man who first described it. A little thought will convince you that this equivalent will perform just like the real circuit it replaces—increase the base current and the drop across Rth increases, lowering the base voltage. Using this equivalent, we can now write Vb = Vth − (Ib × Rth).

The base current, Ib, is just the collector current divided by beta, so we can write Vb = Vth − ((Ic/β) × Rth). This equation and the one marked with an * above have only one term between them that we can't either simply plug in or easily calculate—Ic, the collector current, which just happens to be what we're looking for. Pulling these two together and solving for Ic (and here I'll wave my algebraic magic wand and skip a few steps so we can get on with this) gives Ic = ($\beta \times$ (Vth − 0.7))/(Rth + (β + 1) × Re).

This looks pretty formidable, but let's take a close look and see what it means. An increase in the number on the bottom (Rth + (β + 1) × Re) will reduce the collector current, and an increase in the number on top ($\beta \times$ (Vth − 0.7)) will increase it. This just says that making Rth (R1 and R2 in parallel) bigger or making Re bigger will cause the collector current to go down. This is as expected—increasing Rth should decrease the base current; an increase in Re, for a given emitter voltage, must reduce the current in the emitter and the current in the collector. Similarly, increasing Vth (by raising Vcc or R2) should increase the base current, and so increase the collector current.

Notice that beta appears in both the numerator (upstairs part) and denominator (downstairs) of this expression. If it weren't for Rth down below, we might be able to ignore beta. For example, if beta were equal to 100, we'd have an expression with 100/101 in it—which is pretty darn close to one, and so it could be tossed out. But just maybe we can choose the values for the biasing network so that we don't care about beta—which is the whole idea.

Now that we have an expression for Ic, we can begin to try some designs and see how well they work for varying betas. Before we do this, let me give you a few basic rules of thumb that will usually make this job simpler. First, since we want to minimize the effect of beta on Vb, try to make the current through R1 considerably larger than the base current—say 10 to 100 times as big. We've talked about setting the collector voltage, but what we're usually going to be interested in is the voltage that the transistor sees from the collector to emitter (Vce). Transistor specs will always list a maximum allowable Vce, and we'll want to keep our designs running well within this spec. So, the last two rules deal with this voltage: First, the voltage across the emitter resistor (Ve) should be about the same as Vce. Second, the supply voltage, Vcc, should be around four times Vce (three to five is really OK). This will help keep Vce stable without being excessively large.

With these rules in mind, we'll try a design. Let's go ahead and use the 2N2222A and try for, say, a 5-mA Ic with a 10-V Vce. Using the rules mentioned above, Vcc should be about 40 V and Ve should be equal to Vce at 10 V. With a 5-mA collector current and about the same in the emitter, the emitter resistor will be about 10 V/5 mA, or 2,000 Ohms. Similarly, the collector resistor will have to drop about 20 V, so it should be 20 V/.005 mA, or 4,000 Ohms. The base should be at about 10.7 volts (0.7 V higher than the emitter) and we want the current through R1 to be 10–100 times the base current. With the "worst" beta specified for a 2N2222A being about 100, the base current will be 5 mA/100 = 0.05 mA. We'll make the current in R1 about 20 times this, 1 mA. This gives a value for R1 of (40 V − 10.7 V)/1 mA, or 29.3k. R2 is then 10.7 V/(1 mA − 0.05 mA) = 11.3k.

We now have values for all resistors in the biasing circuit and Vcc. This is shown in Fig. 3. Now that the first pass design is finished, we'll plug these values into our expression for Ic and see how well we did. Rth is R1 and R2 in parallel, or 8.2k. Vth is just Vcc × R2/(R1 + R2), which is 11.1 V, and we'll use 100 for beta, as we did in the original design.

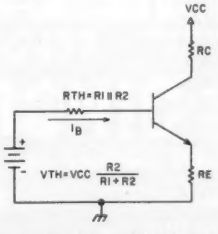

Fig. 2. The base biasing network is replaced by the "Thevenin equivalent" to simplify calculations.

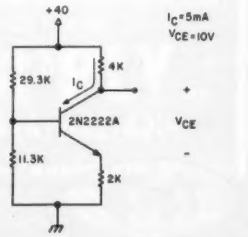

Fig. 3. The circuit designed in the example.

This gives Ic = (100 × (11.1 − 0.7))/(8.2k + (101 × 2k)) = 4.9 mA, and since Ve = 2k × (4.9 mA + 4.9 mA/100) = 9.9 V, and Vrc = 4k × 4.9 mA = 19.6 V, then Vce = 40 V − 19.6 V − 9.9 V = 10.5 V.

These values are pretty close to what we wanted, but let's see what happens with the other extreme for beta—which for the 2N2222A is about 300. Here, Ic = (300 × (11.1 − 0.7))/(8.2k + (301 × 2k)) = 5.1 mA, and Ve = 2k × (5.1 mA + 5.1 mA/300) = 10.2 V, Vrc = 4k × 5.1 mA = 20.4 V, Vce = 40 V − 20.4 V − 10.2 V = 9.4 V.

Again, these are close to our design goals. What's happening here—a three-to-one change in beta, and only a 5-6% change in the output? Look at Fig. 1 again. The emitter resistor is the key to the circuit's stability; as the output current goes up, so does the voltage across the emitter resistor. This forces the base voltage up (constant base-emitter drop, remember?), which in turn forces the base current, and hence the collector current, *down*.

The emitter resistor is acting to provide negative feedback to control the collector current. So, one way to make the circuit more tolerant of changes in beta is to increase the value of the emitter resistor. Another is to increase the current in R1 in proportion to the base current. This means making R1 and R2 smaller, which reduces Rth. As with everything, there are trade-offs to consider—increasing Re will raise the emitter voltage for a given emitter current, possibly requiring larger Vcc, etc. Decreasing R1 and R2 means that more current will be required by that side o. the biasing network. There will also be other constraints placed on these component values by the signal gain and input/output impedances required of this stage, which is another whole area we haven't covered yet—ac performance.

While we're not yet to the point of doing single-stage amplifier design, these articles should have given you a better understanding of how bipolar transistors work and how to begin to design with them. I should mention one other thing, something which I've kept till last because it throws another variable into the works. Throughout this discussion, I've treated the base-to-emitter drop as a constant, at 0.7 V. Actually, it wanders around a bit, too; it can cover as much as a half-volt range or more. But fortunately, the transistor manufacturers will usually supply specs for Vbe for various base or collector currents. Simply choose the number that's right for your design and plug it in everywhere I've had "0.7 V" above. If you can't find a spec for this drop, go ahead and use 0.7 until you can find (or measure) a better number.

This two-part article has been concerned strictly with the dc performance of transistors. We haven't really looked into how they work as amplifiers or how to design for desired gains or input/output impedances. But we've come a long way toward a better understanding of these circuits already. The dc biasing of the transistor has to be right before anything else will work, so make sure that you understand everything we've discussed here. Then begin looking at some simple amplifier designs and how they work—check out some examples in the various handbooks and see if you can apply what you already know about how a transistor behaves to these circuits. And maybe in the near future, if you'd like to see it, I'll come back with another article or two on simple amplifier design. ■

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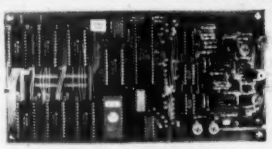

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Are you a ham who is thinking about buying (or just bought) a Yaesu FT-757 with the idea of computer-controlling it? If so, this article is for you. The design details of a simple interface are described. Also, some general program development information is given. A specific example using the Radio Shack MC-10 Micro Color Computer as a controller is shown. Finally, a program for the MC-10 which lets you send commands to the radio, remotely set frequency, and scan a large number of stored frequencies is included.

The FT-757 is a fully-synthesized HF transceiver and general-coverage receiver containing three microprocessors. A smaller package and a much simpler overall design is the result of this innovation. The main microprocessor, an MC-146805G, controls the synthesizer frequencies and permits functions like storing and retrieving frequencies from memory, band stepping, and dual vfo operation. These and other useful functions can be enabled by controls on the front panel.

A feature of particular interest is the interface connector on the rear panel of the radio. This connector accepts serial data from a personal computer and allows the operator to duplicate some functions under program control. It should be noted that the radio design does not permit complete remote control through the serial interface. Functions such as mode, sideband selection, and receive bandwidth can only be controlled manually at the front panel. However, the computer interface does provide an enhancement of the existing radio functions.

Any computer with an RS-232 serial interface capable of driving a printer can be used to control the radio. Fig. 1 shows the serial data format. Note that each data byte contains one start bit (logic 0), 8 data bits, and one or more stop bits (logic 1). It is sent at a data rate of 4800 bits per second. The levels of this signal are TTL-compatible which must be 0 to 0.3 volts for a logic 0, and 2.7 to 5.0 volts for a logic 1.

The standard RS-232 serial data output of a computer swings both positive and negative, and it exceeds the interface voltage limits of the radio. An adapter circuit must be provided between the radio and computer. RS-232 devices send a negative voltage level for a logic 1, so the adapter must also invert the data stream. Yaesu will sell an interface unit specifically intended for this function.

For those eager to try computer control, the circuit shown in Fig. 2 provides a low-cost method. An NPN transistor provides the necessary level translation and inversion. The resistor in series with the base and the diodes help isolate the computer from the radio. The radio has its own internal pull-up resistor to 5 volts, so the collector can connect directly to the radio serial input. No external power supply is required. The high base resistance and the use of the radio's internal power minimize the risk of damage to the microprocessor due to excessive voltage.

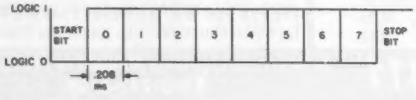

Fig. 1. Serial data format.

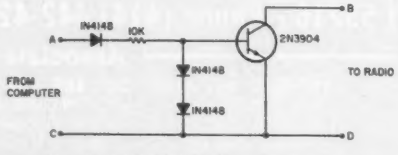

Fig. 2. RS-232 interface circuit.

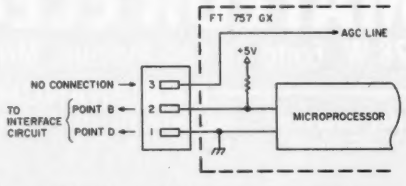

Fig. 3. Radio interface connection.

Construction is not critical, but care must be taken to prevent the circuit output (point B) from shorting to the input (point A) or serious damage to the radio may result. The circuit can be built into a small box or installed directly within the computer.

The completed circuit should be tested prior to connection to the radio. Connect point B to a 1000-Ohm resistor which in turn is connected to a +5-volt supply, and connect the negative supply lead to point D. Connect a 9-volt battery or similar voltage source between points A and C. When A is at +9 volts, B should be less than 0.2 volts, and when A is at −9 volts (reversing the battery), B should be at +5 volts.

The serial input can be found on the rear panel of the FT-757; it is labeled REMOTE. A special interface plug is available from Yaesu for connecting to this serial input. I recommend that you use this part, which can be obtained from your local Yaesu distributor, or write to Yaesu Electronics, PO Box 49, Paramount CA 90723, and ask for part number P1090234. The $1.91 cost includes shipping and handling. If you are unable to get this part, then a temporary plug can be made from a 14- or 16-pin, dual-inline IC socket. Just cut the socket in half (between the rows), trim one half until three adjacent pins remain, and carefully file the plastic until it fits into the serial input socket on the radio.

The connections to the radio are shown in Fig. 3. The center pin is the data line. The ground pin is the one directly below the letter R in the label REMOTE on the radio. The third pin should be left unconnected. This pin has a voltage derived from the radio's agc line. It could be used to measure signal strength.

With the interface installed the computer can send control data to the radio, but the format must be correct for the radio to interpret the commands. To explain how this process works, we must first understand how the computer sends information and what the radio is expecting to receive.

The numbers that a user would type into the computer to select a frequency are decimal (based on powers of ten). When a number is sent over the serial output using an LPRINT command, the number has been translated by the computer to its ASCII equivalent. ASCII (American Standard Code for Information Interchange) is a method of encoding numbers, letters, or symbols to provide compatibility between computers and peripheral devices like printers. The code is sent in binary (based on powers of two) and uses 7 bits, or 128 different numeric values for this representation.

The radio is designed to receive 11 different command codes, which are listed in Fig. 4. The table was taken from *CAT System Serial I/O Data Manual for the FT-757 GX*, available from Yaesu. One of these codes, the frequency-set command, is used to establish the radio frequency setting. Seven decimal digits (10 MHz to 10 Hz) are required to define each frequency. Inside the radio, BCD (Binary Coded Decimal), which uses 4 bits to represent a decimal digit, is the format used for the digits of the frequency setting.

Since each byte the computer sends contains 8 bits, the 7 frequency digits can be sent in 4 bytes. A fifth byte, the command, is required to tell the radio that the preceding 4 bytes represent a frequency. An example of a command setting the radio to 12.34567 MHz is shown in Fig. 5. The remaining 10 command codes require the same 5-byte format with the fifth byte being the command. The data in the preceding 4 bytes, which are not used in the command, is ignored by the radio.

To send the two BCD digits in one 8-bit byte requires a method to overcome the computer's tendency to put everything it sends in ASCII format. Fortunately, there is a command common to most computers that use Basic which will solve the problem. The CHR$(n) command is used when a programmer wants to specify the 8-bit serial data byte directly. The value, n, is a number between 0 and 255 and is the decimal equivalent of the 8-bit data byte.

The problem remaining is to get the computer to convert a seven-digit decimal frequency into the equivalent seven BCD values. Next, it must combine these values into four 8-bit bytes. After adding a fifth command byte, the computer must send these bytes to the radio at the proper data rate.

The problem is solved by first generating an algorithm (a sequence of steps) to turn a two-digit decimal number into an 8-bit data byte, formatted as two BCD digits. Generating algorithms can often be simplified by looking for patterns in numbers.

Fig. 6 shows how such a pattern appears here. The decimal frequency number, its corresponding binary byte in BCD format, and the

No.	Command	Data 1	2	3	4	5	Function
1	SPLIT	X	X	X	X	01	vfo-A/vfo-B SPLIT ON and OFF.
2	MR/VFO	X	X	X	X	02	Exchange operating freq. between memory and vfo.
3	V ► M	X	X	X	X	03	Write vfo data into memory.
4	D LOCK	X	X	X	X	04	Lock tuning dial.
5	VFO A/B	X	X	X	X	05	Exchange operation between vfos A and B.
6	M ► V	X	X	X	X	06	Write memory data into operating vfo.
7	500 UP	X	X	X	X	07	Step up 500 kHz (BAND UP).
8	500 DWN	X	X	X	X	08	Step down 500 kHz (BAND DOWN).
9	CLAR	X	X	X	X	09	Activate or deactivate clarifier.
10	Frequency set	①	②	③	④	10	Enter new operating frequency.
11	V ⇆ M	X	X	X	X	11	Exchange freq. data between vfo and memory.

Fig. 4. Command codes.

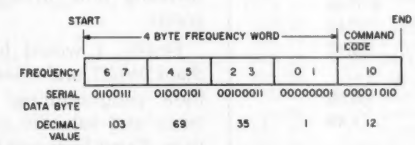

Fig. 5. Command setting frequency to 12.34567 MHz.

Two-Digit Decimal Number	8-Bit Serial Data Byte	Decimal Equivalent of Serial Data Byte
06	00000110	06
16	00010110	22 = 16 + 6
26	00100110	38 = 26 + 2*6
99	10011001	153 = 99 + 9*6
N	—	N + INT(N/10)*6

Fig. 6. BCD algorithm and data pattern.

Notes on the Use of the Interface Circuit

1. Insert the DIN plug into the MC-10 serial I/O socket.
2. Insert the flat connector into the remote socket of the FT-757.
3. Insert the tape into a tape player connected to the MC-10 and CLOAD.
4. Type RUN and enter.
5. The control codes are as follows:

S	= Split mode	F	= Enter frequency
M	= MR/vfo	E	= Save frequency just entered
>	= vfo => memory	/	= Manually scan stored frequencies
L	= Dial lock	H	= Automatically scan (HOP) stored frequencies
V	= vfo A/B	Spacebar	= Exit either scan mode
<	= Memory => vfo		
U	= Band step up		
D	= Band step down		
C	= Clarifier		
=	= Memory <=> vfo		

6. Pressing the above keys will execute the indicated function. When F is selected, the frequency must be typed in MHz, and the enter key pressed.
7. If a frequency is to be saved, press E after entering the frequency.
8. The stored frequencies can be manually scanned (press /) or automatically scanned (press H).

decimal equivalent of the binary byte are shown. This decimal equivalent is the value used in the CHR$ function to transmit the byte. The examples show that by taking the integer part of one-tenth the frequency, multiplying it by 6, and adding the product to the frequency, the decimal equivalent results. Thus, with this algorithm and use of the CHR$ function, a two-digit frequency can be sent as a two-digit BCD value.

The rest of the problem consists of breaking up the 7-digit frequency into 4 two-digit numbers. The Basic program listed in Fig. 7 performs this task by dividing the frequency by 10 and using the integer function a multiple number of times. The numbers are stored in an array which, after use of the CHR$ function, is sent out the serial port by using the LPRINT or similar command.

Commands not requiring a frequency value are handled similarly. The first four bytes sent can be any value since they are ignored by the radio. The fifth byte, however, must represent the desired command. The CHR$ function converts the decimal command value into the binary value needed by the radio. An LPRINT command is then used to send the 5 bytes to the radio, just as before.

A controller incorporating the circuitry and program techniques just discussed was developed using the Radio Shack MC-10 Micro Color Computer. Although many computers will work, this one was chosen for several reasons. It has the necessary RS-232 serial output already built in. The computer is small, it uses the Basic programming language, and it is very inexpensive.

The RS-232 output of the MC-10 connects to the input

```
10 F1=F/10
20 FOR J=1 TO 4
30 F2=INT(F1): F1=F1-F2
40 F2=F2+INT(F2/10)*6
50 A(J)=F2
60 F1=100*F1
70 NEXT J
80 LPRINT CHR$(A(4))+CHR$(A(3))
+CHR$(A(2))+CHR$(A(1))+CHR$(10);
```

Fig. 7. Program listing to create two-digit numbers.

of the adapter circuit. A 4-pin DIN plug (Radio Shack 274-007) must be used here. Connect pin 4 of the computer output to point A, and pin 3 to point C. With the output of the adapter circuit connected to the radio as described earlier, the interface between the computer and radio is complete.

A program listing for the MC-10 is shown in Fig. 8. This program is intended to be used without a continuously-connected TV monitor. A menu which lists the program functions is shown in the box (item 5) of notes. This menu can be cut out and taped to the MC-10 housing.

Carefully type the program into the MC-10, and CSAVE it to tape. Run the program. The functions are enabled by pressing the appropriate key. For example, to enable the dial lock, press L. The LOCK indicator on the radio display should be on. Pressing L a second time disables this function. To enter a frequency, press F, then type the desired frequency in megahertz and press ENTER. The frequency should now be visible on the radio display. The frequency just entered can be saved in the MC-10 by pressing E. All frequencies saved can be scanned manually by pressing /. They can be scanned

```
10 REM****757 CONTROL PROGRAM***
20 REM*****BY ERIK FOUNTAIN*****
30 DIM A(4),B(100): Z=0: N=1
40 FOR I=20224 TO 20243
50 READ D: POKE I,D
60 NEXT I
70 DATA 49,49,60,55,54,214,232
80 DATA 39,8,22,7,54,15,23,126
90 DATA 249,219,126,250,27
100 POKE 17032,126:POKE 17033,79
110 POKE 17034,0: POKE 16932,10
120 B$="SM>LV<UDCF=EH/"
130 A$=INKEY$
140 FOR I=1 TO 14
150 IF A$=MID$(B$,I,1) THEN 180
160 NEXT
170 GOTO 130
180 IF I>11 THEN 220
190 IF I=10 THEN 210
200 GOSUB 400: GOTO 130
210 M=1: GOSUB 400: GOTO 130
220 IF I=13 THEN 270
230 IF I=14 THEN 370
240 IF M<>1 THEN 130
250 M=0: Z=Z+1: B(Z)=F3
260 GOTO 130
270 FOR N=0 TO Z
280 F=B(N): I=10: GOSUB 410
290 FOR P=1 TO 1000: NEXT
300 IF INKEY$=CHR$(32) THEN 130
310 NEXT N
320 GOTO 270
330 N=1
340 A$=INKEY$
350 IF A$=CHR$(32) THEN 130
360 IF A$<>"/" THEN 340
370 F=B(N): I=10: GOSUB 410
380 N=N+1: IF N>Z THEN 330
390 GOTO 340
400 INPUT"F=";F: F3=F
410 F1=F/10+.0000005
420 FOR J=1 TO 4
430 F2=INT(F1): F1=F1-F2
440 F2=F2+INT(F2/10)*6
450 A(J)=F2
460 F1=100*F1
470 NEXT J
480 LPRINT CHR$(A(4))+CHR$(A(3))
+CHR$(A(2))+CHR$(A(1))+CHR$(I);
490 RETURN
```

Fig. 8. Program listing for the MC-10.

automatically by pressing H. To exit either scan mode, press the spacebar.

This program is simple. It is intended to serve as an elementary example. The techniques shown here can be used to develop more elaborate programs for individual applications. It can provide an opportunity for you to be really creative. The serial control capability makes the FT-757, which is already packed with features, even more appealing.

The MC-10 is the only computer I have tried as a controller, and I have experienced no significant radio frequency interference problems. Other computers may cause such interference, so verify that no problem exists before spending time writing programs.

Finally, I would like to thank W6XT and N6MN for their programming assistance and valuable suggestions. Good luck and happy programming. ■

Parts List

Qty	Part Number	Description	Approximate Price
Interface Circuit			
1	2N3904	Transistor	$ 0.49
3	1N4148	Diode	0.49
1	10k	Resistor	0.10
Controller			
1	MC-10	Computer	59.95
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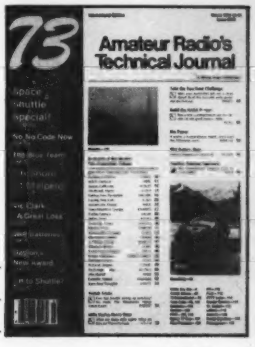

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Assuming you have fairly good antennas in place, the answer may be more power. And a good cheap way to get it is to convert a relic from the past to do the job for you. Many readers will recall the old Gonset company of California. Among their more forgettable products were the venerable Gooney Bird and Sidewinder series of transceivers for 50 MHz and 144 MHz. However, they did at one time make a line of amplifiers that were a great value and still are, if you can find them.

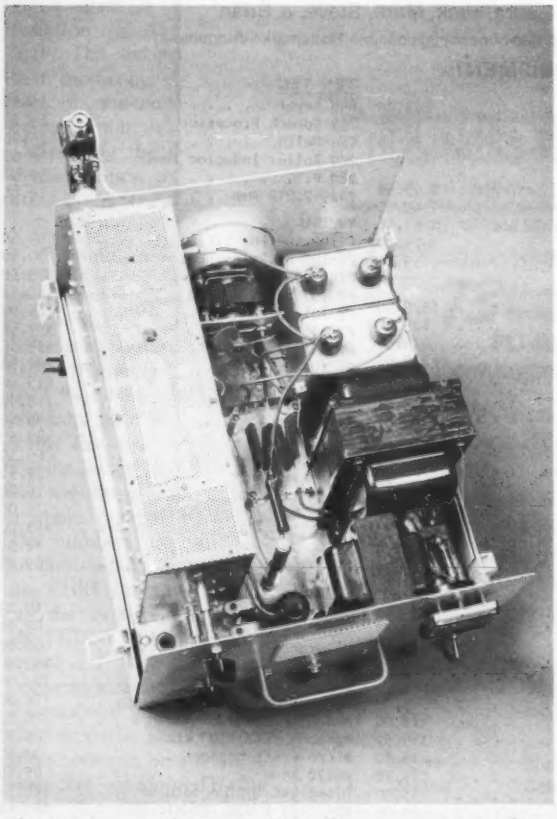


Photo A. Layout of converted 972 after construction is done.

If you are willing to do a little scrounging and soldering (and drill an occasional hole or two), then this conversion is for you. It won't cost much (about $125–$130 all told) and will yield an amplifier that will give you as much as 250–300 Watts of output for as little as 1–2 Watts of drive in the AB_1 mode. Sounds good? Read on!

The Gonset 903/972 series of amplifiers were sold to amateurs and commercial interests alike. 903s pop up at hamfests on occasion, but not cheaply, as they feature a built-in ac supply and will run as much as 400 Watts of output! The 972, however, is a beast of a different sort. Built originally as a 13.8-volt-dc version of the 903, it ran about 90 Watts of output using a 4X150A tube and found use as a mobile power amplifier for business-band use. In fact, many of these are still in service.

The 972, as it is configured, is a real current hog. Power requirements for full output are 13.8 V dc at 35 Amperes, so I wouldn't recommend using it as a mobile amplifier. But electrically it is essentially a 903 with a dc inverter to provide the necessary plate, screen, grid, and filament voltages.

I found my 972 at the Yonkers ARC auction in January, 1984. After studying the tables full of electronic goodies, I noticed a large grey chassis with a screened cover. After removing several nondescript items from on top, it was revealed to be the coveted 972A. This one looked like it had been bounced around a truck for some time, but mechanically it appeared to be fine. Since I had driven some distance and found what I was looking for (sort of), I persuaded the auctioneer to "bump" the order somewhat and put it up for bid.

A spirited round of bidding followed, whereupon the price was driven up to $80.00, at which point I prevailed. Shortly thereafter, while making settlement at the head table, my opponent came up, took a long look at the 972, and said to me, "Just what is that thing, anyway?" Oh, the fates are cruel.

Our group trundled home and I hastily removed the cover of my prize. All appeared OK and the tubes displayed markings and date codes circa 1974. A quick reference to the owner's manual (invaluable) told me what was to go. After locating the soldering iron and a pair of diagonal cutters, I

went to work. Refer to Figs. 1 and 2 to see the top and bottom layout of the 972 with the spring latch cover and bottom removed.

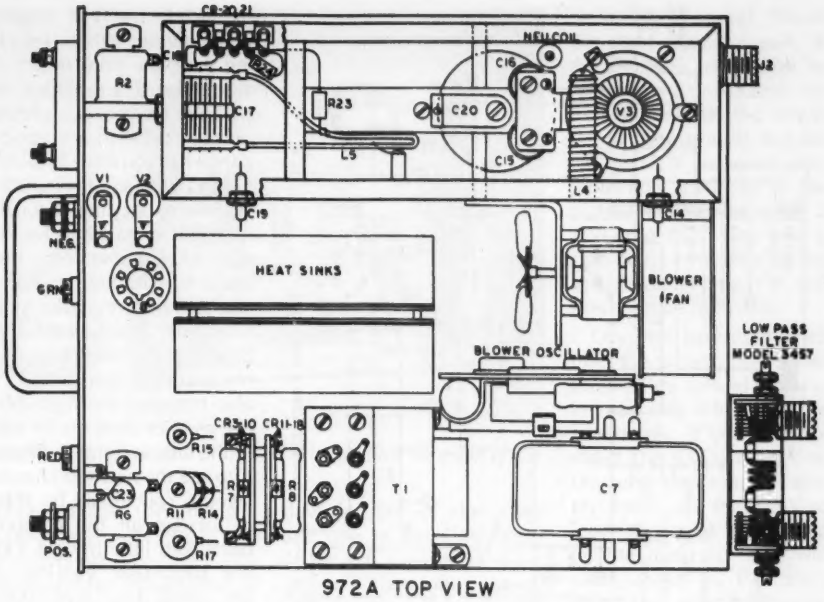
Assuming you've read this far, I am sure you have the appropriate tools in hand, so let's begin the conversion. The following items from the top of the chassis will have to be removed: C7, T1, CR3–10, CR11–18, R2, R7, R8, R6/C23, R11, R14, R15, and R17, as well as the assembly marked Heat Sinks. Also, remove the assembly marked Blower Oscillator but *not* the blower. Leave the rf chassis and 8-pin plug and socket intact, as well as the sockets for V1 and V2. Remove the tubes (2 × 0B2) as you'll have to replace them with 0A2s.

Save all the power resistors, as you will need some of them later. The rest of the components can be trashed. Also, remove the low-pass filter assembly from the rear panel. You won't need it and it won't handle the power you'll be running when you're finished. The unit was only put on for FCC certification purposes and the amplifier runs cleanly enough without it.

Now, it's time to tackle the chassis underside. Flip the unit over and remove the following components: K1, C1, C2, C8–9, C24–25, T2, PL1–2, R1, R5, CR2, R12–13, R9–10, R37, and CR19. Leave R25 and 26, as these are used in the rf power sensing circuit. R27 can be removed. Discard the other components except C8 and C9, which can be used in the bias supply. Also, retain the Bakelite™ support plate that they were on to hold the bias-supply parts.

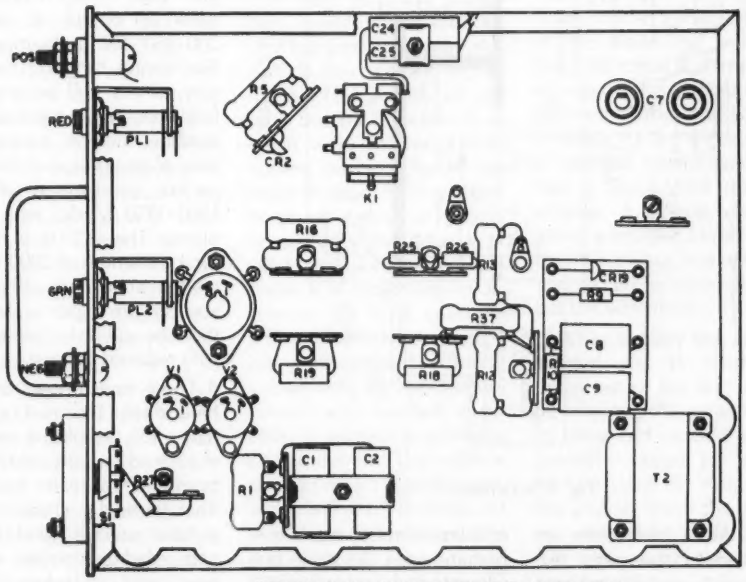
You will now need to locate a high-voltage plate transformer, preferably something on the order of 1200–1400 volts of output at about 350–400 milliamperes. You'll also need to locate a multi-tap power-supply transformer with the following voltages available: 350–400 volts at 50 milliamperes and 6.3 volts at 2.5 Amperes. If it also has a 5-volt winding, so much the better. Incidentally, this latter transformer is commonly found in smaller TV sets from about the same period. The last transformers you'll need are: 25.2 volts at 3 Amps (common Radio Shack item) and a transformer for the grid-bias supply. The latter can be either a 6.3-volt unit with its 117-V-ac primary connected backwards to the 5-volt winding on the multi-tap transformer, or a standard 117-V-ac primary/125-V-c-t secondary at 15 milliamperes.

Additional items required are filter capacitors for the HV supply, screen supply, and bias supply, HV diode rectifiers for the plate and screen, low-voltage rectifiers for the bias supply, various zener diodes, ballast and dropping resistors, indicators, fuse holders, switches, and a meter for the front



972A TOP VIEW

Fig. 1.



972A MAIN CHASSIS, BOTTOM VIEW

Fig. 2.

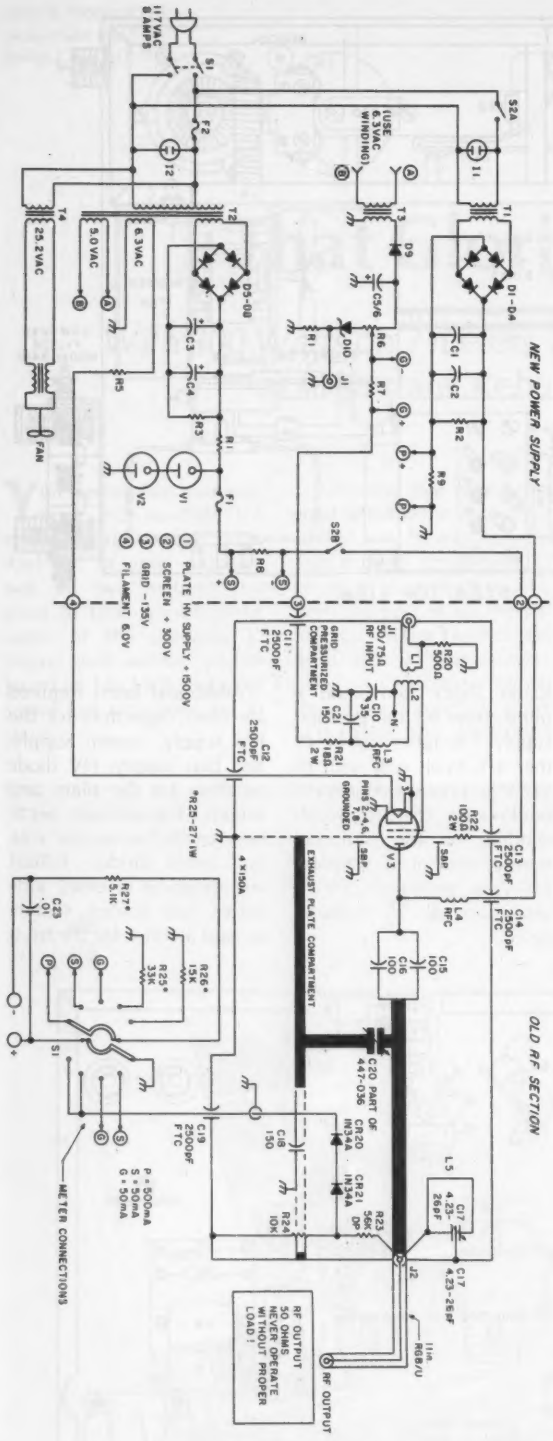


Fig. 3. Schematic.

panel. All of these items are itemized in the parts list, along with possible sources for each item. You may be able to come up with most of them from flea markets—perhaps even the same one where you picked up the 972 itself!

The first line of business is to install the HV supply components. When selecting the plate transformer, it would be a good idea to measure the space available on the chassis to accommodate what you have in mind. I won't give any firm guidelines here, but allow enough room for at least 2 high-voltage filter capacitors, the plate transformer, and the screen transformer (the multi-tap unit). Don't forget, the blower can't be moved. On my particular conversion, I also mounted the high-voltage rectifier stack on the top of the chassis (refer to Photo A to see the new top chassis layout). You should be able to arrange all the components with little trouble. On my particular version, I am using two 6-μF/2000-volt filter capacitors for the plate supply filter. The original transformer shorted out after a month and the replacement just made it between the capacitors and the multi-tap transformer. If you plan this carefully, you might be able to use a lot of the existing mounting holes on the chassis.

As was mentioned earlier, you should try to locate a plate transformer that will give you about 1200–1400 volts of output at about 300–350–400 milliamperes. The center tap isn't necessary, as you will be using a full-wave bridge-rectifier assembly, thereby increasing your plate voltage at the capacitor terminals to about 1500–1750 V dc, which is plenty. The 4X150A is rated for a maximum of 2000 V dc on the plate and, although you can run higher voltages, the tube will last a lot longer with reduced voltages.

These transformers aren't hard to find. I located one as part of a surplus Lambda regulated supply ($15.00) from a scrap dealer nearby. That particular chassis also yielded several good filter caps, sockets, power resistors, and switches. Fair Radio Sales in Lima, Ohio, is an excellent source for the transformer. As a matter of fact, they can probably supply most of the parts needed for the conversion, and a copy of their latest catalog would be most helpful.

Once you have mounted the plate supply, filter capacitors, and rectifier assembly, you should now mount the multi-tap transformer for your screen and filament voltages. I located mine just behind the front panel, but forgot to allow enough clearance for the meter, so it sticks out from the panel a bit. Oh, well! Locating the multi-tap transformer behind and just to the right of the screen mesh in the panel is an excellent location, mainly because the holes have already been drilled to pass the various leads through to the underside of the chassis! (How lazy can you get?) It is a simple matter to then use an existing terminal strip (which you've already stripped of components) to mount the full-wave bridge circuit for the screen supply (should yield about 350–400 volts); the filament leads will make it to the 8-pin socket without any trouble. This socket feeds the various voltages (except plate) to the 4X150A, such as screen, bias, filament, and also a return that carries sampled rf voltages for the power output meter.

Assuming you now have the multi-tap transformer working, the next step is to wire up and test the two supplies (plate and screen). You should pick up some HV test-probe wire (5-kV insulation, #18 stranded) for hookups on the plate. This is a common item and most electronics supply houses have it on the shelf. The balance of your hookups can be made with #22 for everything except the filament and blower connections. It would also be a good idea to procure a premolded, 3-conductor, #16 ac power cord with plug and bare ends (about 4–5 feet). Or, you can buy the wire and plug at an

electrical supply house for a modest cost.

Wire the plate supply as shown in the schematic (Fig. 3). Keep the leads short and retain the connector that goes to the HV-bypass feedthrough capacitor on the rf deck. Wire both capacitors in parallel but don't ground them as yet. Also, don't ground the − lead on the full-wave bridge! Connect the − sides of the filter caps and the − of the full-wave bridge together. You will also have to construct a bleeder assembly for the supply to improve regulation and to discharge the capacitors when not in use. Using the long 4-40 screws that held up the original bleeder assembly, salvage the 100k, 20-W and 25k, 25-W resistors that were previously stripped from the chassis. Configure a series resistance using the two of 125k Ohms and connect across the high-voltage + and − terminals (we're still above ground here). This will result in a bleeder current of 10–15 milliamperes, depending on your actual plate voltage. You'll need a dissipation of about 20 Watts total in the resistors and you have 45 available, so you are all set.

The next step is to either find, make up, or buy a .3-Ohm, 2-Watt resistor for your meter shunt. These are not uncommon at hamfests and you can string together different values to make it up. This then goes from your − connection (capacitors, full-wave bridge, and bleeders) to ground. This ground return path is at a low potential voltage, which makes it a very safe place to put a meter in the circuit to measure plate current. With the indicated shunt and about 1600 volts on the plate, the meter reads about 500 mA full scale. We'll get to the meter hookups later.

Test your supply by applying ac to the primary and using a Simpson 260 or equivalent meter with a 5-kV range. Look for correct plate voltage, then cut the power and verify that the bleeders are doing their job. Plate voltage should drop to zero in about 10 seconds. If all is well, you're ready to wire up the screen-voltage supply. Locate the windings desired (in my case, it was a 700-V-c-t unit, so I used one side and the center tap for 350 volts) and wire up the screen full-wave bridge. This can be done on an adjacent terminal strip under the chassis, or you can mount a new one. You'll need to locate two 40-μF, 450-V-dc electrolytics for the filter capacitors. Again, these are common items at hamfests. Whatever you use, the desired filtering is about 75–90 μF at 450 V dc.

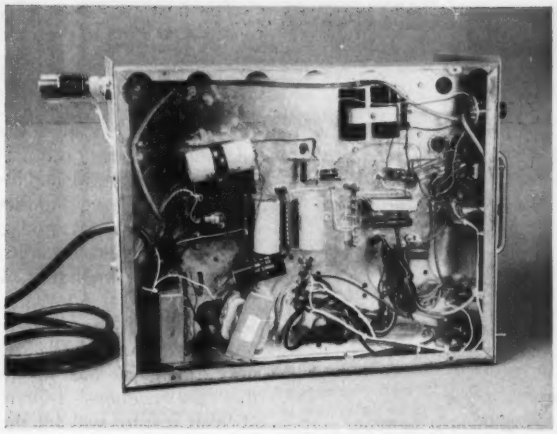


Photo B. Bottom view of the 972 with all final wiring in place.

Once this is done, you will have to configure the resistors: first, a dropping resistor for the regulator tubes. Simple calculations will yield the value needed: In my case, the output of the full-wave bridge with filter capacitors was about 435 volts. The maximum screen current on the 4X150A is 30 milliamperes, and the VR tubes (2 × 0A2) don't want to see more than 300 volts. The required drop is 435 − 300 = 135 volts/.030 = 4500 Ohms. Assuming normal use of the amplifier in class AB_1, chances are you won't exceed 20–25 milliamperes of screen current (unless you're driving the living daylights out of the tube) and one of the 5000-Ohm, 10-Watt resistors you stripped from the chassis will fit the bill perfectly. Your screen dissipation will be on the order of 3–4 Watts, so the 10-W rating is more than enough.

Now that you have dropped the voltage to the VR tubes, you'll also need to make up a screen bleeder. The guiding factor is that you want the screen supply to dissipate as fast or faster than the plate supply; otherwise, you'll pop the screens on the tube. I've also used a fuse here for extra protection—more on that shortly.

What kind of bleeder current do you need? Well, not much! The screen of the tube doesn't draw much to begin with, so the bleeder current ought to be on the order of about 5–10 milliamperes. Let's do some calculations: 300 volts/.010 mA = 30k Ohms. Some experimentation is in order here to determine the time constant, and rather than use math, I just tried several different values until the satisfactory current was reached, especially in relation to plate-discharge current. This value is close to what I actually used, which is about 33k Ohms. At this level, all you need is a 2-Watt resistor.

Make sure that the VR tubes are the last piece of the chain that goes to pin 3 on the octal socket. This is the most critical supply in the amplifier and it must be filtered and regulated extremely well for the amplifier to behave itself in a linear mode. If you want extra protection, such as if the plate supply fails, install a 1/10-Amp AGC fuse (*not* a slow-blow) in series with the screen-voltage line. This will prevent tube blowouts.

Once you have established that the screen and plate supplies are up and running, the next step is to tackle the bias supply. If you have located the 117-V-ac/6.3-V-ac filament transformer, simply hook up the 6.3-V-ac leads to the 5-V-ac winding on the multi-tap. This will yield about 95–100 volts from the now-backwards primary winding. A single diode is sufficient for this supply, as it doesn't draw much current at all and regulation is not a problem. You'll see about 120–130 volts at the output, but here's the catch: You must hook up the diode reversed, since we need negative bias! No sweat here, as the cathode (banded) end goes to one side of the transformer, with the other transformer lead grounded. The output is taken from the anode side of the diode and a 40-μF, 250-V-dc capacitor from the salvaged parts is connected backwards from it to ground—minus to the anode, plus to ground. Next, locate or buy a 5k, 5-Watt potentiometer, a 33-volt, 5-Watt zener, and a 1k, 2-Watt resistor. This is your bias network and should be connected as per the schematic.

When the key line at J1 is shorted, the 1k resistor is taken out of the line, thereby allowing the zener to do its thing and provide an adjustable range of about 50–120 volts dc. Removing the ground raises the standby voltage back to about 135 or so, putting the tube in hard cutoff. Mount the components on the Bakelite board that was rescued ear-

Photo C. The finished conversion with new lettering and a new paint job.

lier from the garbage and locate the bias-adjustment pot in a convenient location. I placed mine behind the filter caps inside the chassis to prevent accidental readjustment.

Note: If you chose the more conventional 117-V-ac/125-V-ac transformer, simply hook it up to your ac source and wire as before on the secondary. Your voltage range will be greater when adjusted and will sit at about 150–160 volts when on standby.

Verify that your supply will give you from −130 to −50 volts when J1 is grounded and R1 is adjusted. It should be a smooth adjustment and be stable when set. Where you set this pot will determine your class of operation. For example, a setting of −100 to −90 volts will put you in class C and the tube will need more drive for a given power output. This is appropriate for FM use only. Dropping the voltage to about −60 to −50 volts will put you in about class AB, where the idling plate current will be close to 80–100 milliamperes, and you'll need only about 1–2 Watts of drive for full power output.

OK, let's step back and inspect our work. The plate supply is now up and running. The screen and grid-bias supplies are also behaving as intended. You're almost done, believe it or not!

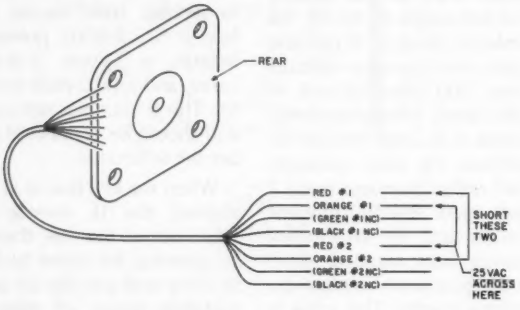


Fig. 4. Wiring diagram for modified blower. Of the eight wires, don't use either set of black or green wires. You'll need to determine which are the correct pairs by shorting one of the red wires to one of the orange wires and connecting 25 volts across the other two. If the blower won't turn, try the other red wire to the same orange wire and change 25-volt connections accordingly.

The next step is an easy one. You'll have to drop the filament voltage to the 4X150A to exactly 6.0 volts, as per Eimac's ratings. To do that, you need to know the filament current requirements (2.1 Amperes), and using simple math we find that 6.3 − 6.0 = .3 volts need to be dropped. Also, .3 volts/2.1 Amps = .14 Ohms. (2.1 × 2.1) × .14 = 6.1 Watts. So, you'll need a .14-Ohm, 6-Watt resistor? Well, my past experience has shown that the average .1-Ohm, 10-Watt resistor will fill the bill, yielding a filament voltage around 6.08 volts. For the intermittent use the tube will get, you're not shortening its life by any drastic amount, or even any appreciable amount! So, go ahead and use a .1-Ohm, 10-Watt resistor. These always show up in surplus houses and flea markets for a song. (I bought 5 at Dayton for 10¢ apiece.) Run the wire from this resistor to pin 8 on the octal socket and ground the other side of the filament lead for the return. If you haven't done so already, also hook up the grid bias to pin 2 of the octal socket.

If you want to use the multimeter switch and meter to also measure grid and screen current (and who doesn't?), you'll need to dig up or buy a couple of 3.3-Ohm, 2-Watt resistors. When the meter leads are across these resistors (in series with the screen and grid supplies), the meter scale reads about 30 mA full scale, which is perfect. Use one resistor for each supply. You can use existing terminal strips to secure the resistors, which should be installed right before the voltage goes to the octal socket.

By now, the bottom of your supply should be looking something like Photo B. Notice the neat layout and extensive use of cable ties and dressed leads. This makes troubleshooting a lot easier.

The next step is to install the new blower supply. This is nothing more than a Radio Shack 25.2-V-c-t, 6-Amp transformer. You'll have to wire the blower very carefully, however, as it was designed to run from a flip-flop supply that is nowhere near 60 cycles. The trick is to find the red and orange enameled wires and wire them in a series-parallel arrangement, as shown in Fig. 4. I fried another transformer by not doing this, as the current demands became excessive.

At this point, it would be a good idea to check all of your wiring. You should have plate, screen, grid, and filament voltages both in position and working correctly. The blower should also come up to speed and the transformer may run a little warm, but that's it! Again, refer to Photo B for the final layout. You may have to jockey the blower transformer around a bit to find the best compromise to get at the leads (which are quite long) and clear the other components. Take your time and be neat. Mark your wires well for later identification when hooking up the switches and lamps.

Now, the fun part begins. You are ready to install the switches and indicator lamps on the front panel, the fuse holder for the ac mains, a power cord on the back, and a jack for switching the bias control when in standby. It might be a good idea to consider sanding and repainting the chassis (see Photos C and D). If you are so inclined, you can also reletter all of the controls with transfer type and then spray the panels with a clear finish, like Krylon, for protection. Chances are if your 972 looks anything like mine did when I picked it up, it'll need a paint job.

It's time to do the front panel! One item I didn't scrimp on was a meter. Calectro makes a fine unit with a front-panel scale of 0–1 mA (catalog #D1-1012). It retails for about $15.00 and

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D1–D4	1N5408 type, 3 A, 1000 piv	Jameco	3/$1.29
C1–C2	Either three 4 uF at 20000 V dc	Fair Radio	4.00
	or one 12 uF at 2000 V dc	Fair Radio	12.00
R2	Bleeder—from 972 parts		
Screen Supply			
T2	117-V-ac primary, 700 V c-t at 50 mA 6.3 V at 3.5 A 5.0 V at 2.0 A	Fair Radio	5.95
D5–D8	1N4007 type, 1 A, 1000 piv	Jameco	10/1.29
C3–C4	50 uF, 350 V, axial	Fair Radio	.65
V1–V2	0A2 regulator tubes	Fair Radio	2.50
R3	Bleeder—from 972 parts		
R1	Dropping resistor—from 972 parts		
F1	Fuse, 1/10 A, 250 V, AGC	jobber/flea market	
Grid-Bias Supply			
T3	117-V-ac primary, 6.3-V secondary (hook up backwards to 5-V winding on T2)	Fair Radio	
D9	1N4004 type, 1 A, 400 piv	Jameco	12/1.29
C5–C6	From 972 parts		
D10	33-volt, 5-Watt zener (ECG or HEP)	jobber/flea market	
R4	1000-Ohm, 2-Watt carbon	jobber/flea market	
J1	RCA female chassis mount jack	Radio Shack	
Miscellaneous			
F2	Fuse, 8 A, 250 V (AGC-8 or MDL-8)		
M1	0–1-mA miniature panel meter (Calectro D1-1012)	jobber/flea market	
R5	.1-Ohm, 10-Watt resistor	Fair Radio	
R6	5k-Ohm, 2-Watt potentiometer	Jameco	
R7–R8	3.3-Ohm, 2-Watt resistors	Jameco	
R9	.3-Ohm, 2-Watt resistor	Fair Radio	
S1–S2	DPST switches, 8-A, 125-V-ac rating	Fair Radio	
I1–I2	NE-51-type indicator lamps, or preassembled 120-V-ac indicator assemblies	Jameco	
T4	117-V-ac primary, 25.2-V secondary	Radio Shack 273-1512	5.99
	Fuse holder (2)	Jameco	
	Ac cord and plug	jobber/flea market	
	Shaft couplings (2) and extensions	Fair Radio	
	Knobs, 1/4" (3)	Radio Shack	

Note: Prices and sources for some parts are not specific due to widespread availability, both surplus through Fair Radio and at flea markets. You should have little trouble finding what you need. For a free copy of Fair Radio's latest catalog, write Fair Radio Sales, PO Box 1105, Lima OH 45802.

is available in most electronics parts stores. With the shunts called for, it will give you the current ranges desired—0–500 mA for plate current and 0–30 mA for screen and grid current. If you're clever, you might find a way to mount it to cover the two terminal-strip knockouts. If you're lazy (like me), you can mount it above the Meter callout and leave the other hole blank. The leads that went to the terminal strip now go right to the meter. I ran all new shielded two-conductor cables to all sampling points and the meter itself. *Caution*: Check the polarity on the grid-current resistor, otherwise the pointer will go off scale reversed and possibly damage the movement.

Eimac tells us that 4X150As last longer if the filament voltage is allowed to come up without plate and screen voltages for about 3 minutes. To facilitate this and solve the tricky problem of bringing the plate and screen voltages up at the same time, I wired up a Plate switch on the front panel. This is nothing more than a DPST switch, one side of which controls the plate primary supply and the other of which cuts off the screen voltage right before the octal socket. If you place the switch as I did, you'll find that it lines up perfectly with the socket. An indicator light can be placed across the primary to show plate power is "up."

A good place for the ac mains fuse is right behind the meter on the top chassis. I used a clip-in-type fuse holder. If it blows, the cover can be quickly removed to gain access. Make this a 8–10-Amp MDL slow-blow for the current surge when the plate capacitors charge up. Wire your primary ac switch to bring up the grid-bias supply, filament voltages, and blower. Install an NE-51-type indicator across the transformer primary. If you are using a multi-tap transformer, wire its primary in parallel with the blower. This will bring up the grid supply, blower, filament, and screen, but the screen won't be in the circuit until you throw the plate switch.

Now you are ready to test the tube! You'll need a couple of voltmeters capable of reading 0–250 V dc and 0–2000 V dc. Connect the minus lead of the first to the bias line and ground the positive lead. Using high-voltage probes, *carefully* connect the positive lead of the second meter to the capacitor terminals and the negative lead to the minus side of the supply—*not ground*. Connect the HV-to-rf-compartment plug and plug in the octal plug. If you haven't done so, remove the screws that hold the rf compartment cover down. *Be careful—there is plenty of high voltage present!*

With the 4X150A in the socket and seated, turn the ac power on. Wait three minutes for the tube to warm up. Then, turn the plate supply on. You should be seeing about 1500–1700 volts on the plate and −135 to −150 volts on the grid. (You can also verify the 300 volts on the screen if need be, but the 0A2s should be glowing purple at this point.) With the bias-adjust control at its maximum resistance, ground J1. You should see somewhat of a drop in the grid voltage. While keeping J1 grounded, adjust R1 for about 100 milliamperes of plate current. Then, remove the ground from J1, and the plate current should drop to zero.

Again, ground the key line and verify that the plate current is back at about 100 milliamperes idling. If so, you have now set the tube to run in class AB_1—linear. The blower should be forcing a little warm air around the tube chimney. At this point you are running about 150 Watts dissipation (not power). If the above instructions check out, you're

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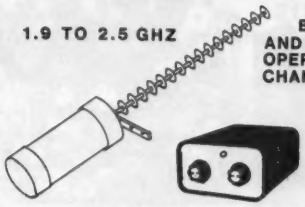

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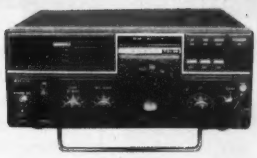

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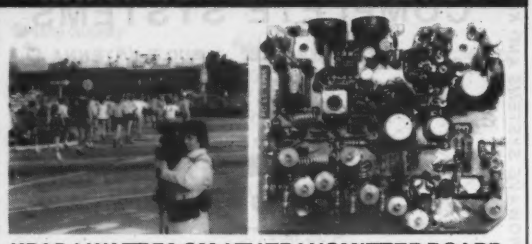

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ready to drive the tube and make power.

Note: If at this point the idling current still reads zero or very low, you may either have a bad tube or insufficient screen voltage getting to the tube. Check all connections carefully.

Connect your exciter (preferably 1–2 Watts—an HT is fine for tests) to the input connector on the back using a short length of cable. Connect either a 300-Watt dummy load or an antenna to the output jack on the back. Turn the plate switch on and key your rig or exciter. Using a dummy load, peak first the grid and then the plate-load controls on the front panel for maximum output with minimum grid and plate current. On most of the 972s, you will also have to tune the plate capacitor for resonance. This is a screw next to the tube inside the plate compartment. *Caution: This screw has plate voltage on it. Be careful!* Use a noninductive tuning tool to make the adjustment. In most cases, once you set this screw, you can make excursions across 2 MHz or so without an appreciable loss in power.

Carefully tune plate and grid for maximum output. You'll find that in AB_1 it will take only about 1–2 Watts to give 250–300 Watts of output power. Not bad, eh? That's close to 20 dB of gain, and think of what your 16-dB-gain antenna can do with that! If you prefer to run more drive power, simply set the idling current lower to about 50 mA, and it will take more drive (5–10 Watts) to achieve full output. What is full output? The 4X150A is rated at about 250 Watts maximum dissipation and peak current of 400 mA in SSB operation. Keeping the current down to 300–350 mA is a good idea, and you'll still be making lots of power.

The 4CX250B can be substituted with equally effective results. The only difference is that 4X150As are frequently available at flea markets for as low as $5.00 each, used, while good used 4CX250Bs generally run more than $15.00 each. You'll also find the spectral purity of this amplifier is excellent, making it ideal for repeater use. It'll sit all day and run 100 Watts without breathing hard!

You can obtain shaft couplings and extensions at flea markets to bring the plate-load and grid-tuning controls out to knobs on the front panel as I did. Or, you can just make the adjustments with a screwdriver, as they won't drift much. The key line to J1 can be hooked up to any radio with an external-amplifier keying jack. If you prefer, the circuit in Fig. 5 shows a simple rf sniffer using a Darlington transistor to switch a relay and establish bias. Additionally, if you have a Dow-key relay for the antenna line, you can hook it to the output and use the spare contacts to set the bias. Simply run the line from J1 to the relay instead and ground the closure contact. 12 V dc for the relay can be obtained from a diode off the tap on the blower transformer (sneaky, eh what!) and the jack on the rear panel can be used now to create the ground return for the relay operating voltage. This is the method I use, with an ICOM IC-740 driving an MMT 144-28 into the amplifier. The ICOM has an RCA jack that will key on transmit.

And there you have it! A 300-Watt, tube-type VHF amplifier for a nominal sum and some weekend work. If this doesn't get you on 144-MHz aurora, I don't know what will! If you have any questions about the amplifier when building it, send along an SASE for the reply, and I'll try to help out.

I would like to thank Steve Katz WB2WIK, who was most helpful with the conversion and convinced me to write this article, Mike Crawford WA2VUN, who punched the front panel at his shop, and my wife, Gayle KA9ESB, who sees all these "boxes" disappearing into the basement and doesn't give it a second thought.■

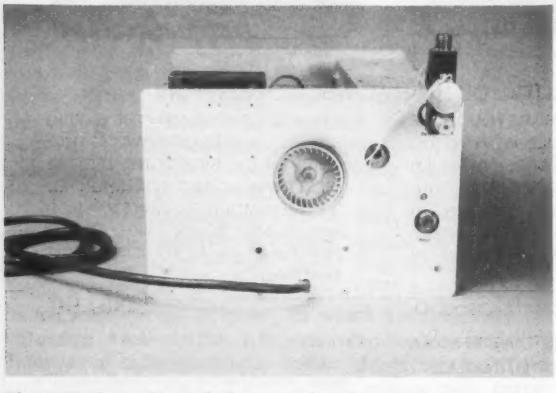

Photo D. Rear view of the completed unit after repainting. Note the position of the rf keying jack.

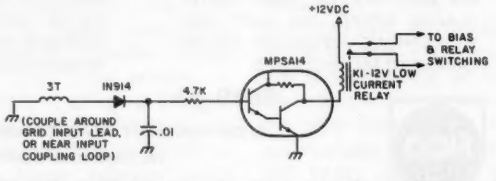

Fig. 5. Rf sniffer circuit—for keying with any radio using sensed rf.

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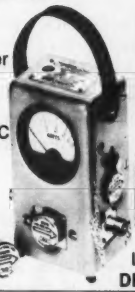

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Stuffing full-wave 40m loops into tiny places is W8TYX's specialty. We finally got him to tell us how he does it.

When my only antenna, a roof-mounted vertical for 7 MHz, failed during the winter, I was not able to repair it because of the cold weather. I needed a replacement, but no trees, towers, or tall buildings were available for supports. After some experimentation I arrived at a (more or less) horizontal loop antenna which has performed surprisingly well.

Fig. 1 shows the general layout of the loop antenna. It is a closed loop with a total electrical length of about one wavelength at 7 MHz. I used no. 20 copper wire because that is what I had; the size of the wire is not important.

The loop begins under the house eaves about 8 feet above the ground and continues to the corner of the house about 24 feet away.

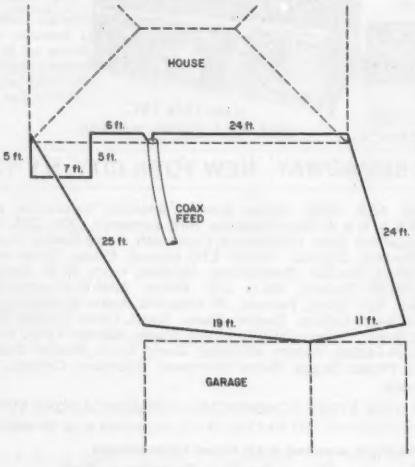

Fig. 1. General layout of the loop antenna.

The loop continues from the corner of the house to the corner of the garage, a distance of about 24 feet. The corner of the garage is about 7 feet above the ground. From there the loop continues to the peak of the garage roof, a distance of about 11 feet where it reaches its highest point, about 11 feet above the ground. The loop then continues to the far corner of the garage, a distance of 19 feet, descending to a height of about 7 feet.

From there the loop goes to the eaves under another corner of the house, a distance of about 25 feet; the height here is about 8 feet. The loop then goes vertically down the side of the house about 5 feet. The purpose of this "jog" in the loop is to add length and make the antenna resonant at the desired frequency in the 7-MHz band. The loop then goes horizontally for a distance of about 7 feet, then more or less vertically back up to the eaves, and then horizontally for a distance of 6 feet back to the starting point.

The loop is fed at the starting point with RG-8 coaxial cable. One end of the loop is connected to the center conductor of the coaxial cable and the other end of the loop is connected to the shield.

The jog in the loop, described above, was not in the original version of the antenna. It was added after measurements with a noise bridge showed that the resonant frequency of the antenna was too high. The dimensions cited above were not "designed." Rather, I used the space and the supports which were available and then adjusted the overall length of the loop to make it resonant at the desired frequency near the low end of the 40-meter band.

If you build a similar antenna, use what you have in the way of space and supports and start with a total length of the loop equal to about one wavelength at the desired operating fre-

quency. A wavelength is given by the expression: $\lambda = 935/f$ where λ = wavelength (feet) and f = frequency (megahertz).

After you have erected the loop with the calculated total length, measure its resonant frequency using a grid-dip meter, an swr bridge, or a noise bridge. The calculated length is just a starting point. The resonant frequency of the antenna will be affected by the presence of nearby objects and its height above ground. Adjust the length of the loop to obtain the desired resonant frequency. An increase in length will decrease the resonant frequency, while a decrease in length will increase the resonant frequency.

Fig. 2 shows the vswr (voltage-standing-wave ratio) of the completed loop as a function of frequency for the 40-meter band. These measurements were made at the far end of a 50-foot length of RG-8 coaxial cable which was connected to the loop. The bandwidth for a reasonable vswr covers most of the CW portion of the 40-meter band. I do not have equipment to measure the impedance of the antenna, but the minimum vswr of 1.2 to 1 indicates that the driving impedance at resonance is a reasonable match for the 50-Ohm impedance of the coaxial feedline. Measurements of my (repaired) vertical antenna are shown for comparison.

A horizontal loop antenna radiates most of its energy at high angles with respect to the earth. So this is not a low-angle DX antenna. However, on 7 MHz it performed well on short hops out to a few hundred miles. The best DX I worked using this antenna was OK1APV in Czechoslovakia, but band conditions were good that night. It consistently performed well with stations out to about 500 miles; beyond that distance my vertical antenna did better.

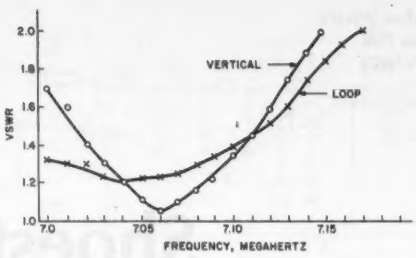

Fig. 2. The vswr of the 7-MHz loop.

After the 10-MHz band opened, I shortened the overall length of the loop and made it resonant for that band. Fig. 3 shows the vswr of that loop across the 30-meter band; it is less than 1.2 to 1 over the entire band. I have worked VK3AGW twice using this simple antenna.

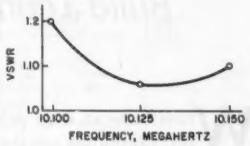

Fig. 3. The vswr of the 10-MHz loop.

If you are stuck without an antenna or just want to try a different type of antenna, give this horizontal loop a try. It's not a world-beater for DX, but it is simple, easy to put up and adjust, and works reasonably well. That's a good combination. ■

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My first attempt was a very simple circuit using phase-locked-loop tone decoders to detect the mark and space tones. It had post-detection filtering and one bandpass filter on the input. It performed perfectly under "laboratory conditions," but in the real world of amateur-radio bands, the printout was often rather confusing. Something better was obviously needed.

Having heard that active filters were hard to design, build, and adjust, I was reluctant to begin design of a filter-type decoder. I rather cautiously breadboarded a basic state-variable filter circuit using the TL-084 bi-FET op amp and found that it worked perfectly on the first try, didn't oscillate or ring, and provided a very high Q at the design frequency which came out exactly where the formulas had predicted. Since that was the hard part of the design, the rest went smoothly and I was on the air with just a few days work and only about $30 spent out of the ham-radio budget.

Fig. 1 shows the circuit diagram of the interface. I feel it is about as simple and straightforward as possible without compromising performance. All switching is done with single-pole switches and no tuning is required after initial setup. The switching arrangement lends itself well to push-button operation and a very modern look is possible using the switch assembly shown in the accompanying photographs.

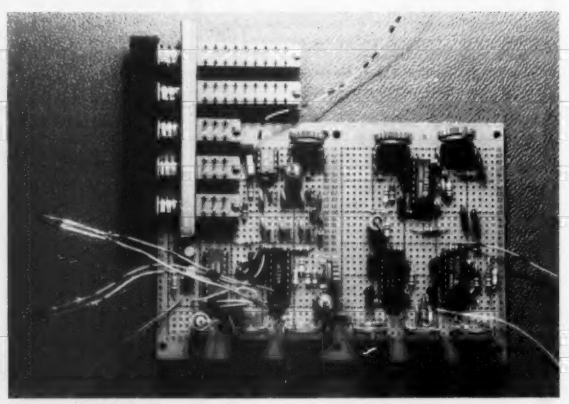
How It Works

The audio signal enters at J1 and goes through a bandpass filter (BPF) centered at 2210 Hz. This filter is used only for 170-Hz-shift RTTY and can be switched out with S1 for wider shifts.

The signal then goes to U1, a 741 op amp, which with S2 closed operates as a limiter, producing a square-wave output at the frequency of the strongest signal in the passband. With S1 open, the op amp operates as a conventional amplifier that does not clip the signal at normal volume levels. Normal operation is in the FM or limiting mode, which provides better performance on weak or noisy signals. The AM mode can prove useful if there are two signals close together and the tendency of the limiter to capture the stronger signal is not desirable.

The output of U1 is then attenuated slightly by the voltage divider consisting of R4 and R5 so as not to overload the following filter stages. It is fed to the inputs of three BPFs consisting of a 2125-Hz filter for the mark tone and 2295- and 2550-Hz filters for the space tones corresponding to 170- and 425-Hz shifts, respectively. The reason for choosing these shifts is that my primary interests are in ham operation on the HF bands (nearly all 170-Hz shift) and commercial shortwave teletype (usually 425-Hz shift). Any shift can be copied in the single-tone mode (selected by S4). Since 850-Hz shift

The completed interface. The round object above the switches is the tuning meter.



The circuit board with the switch assembly attached.

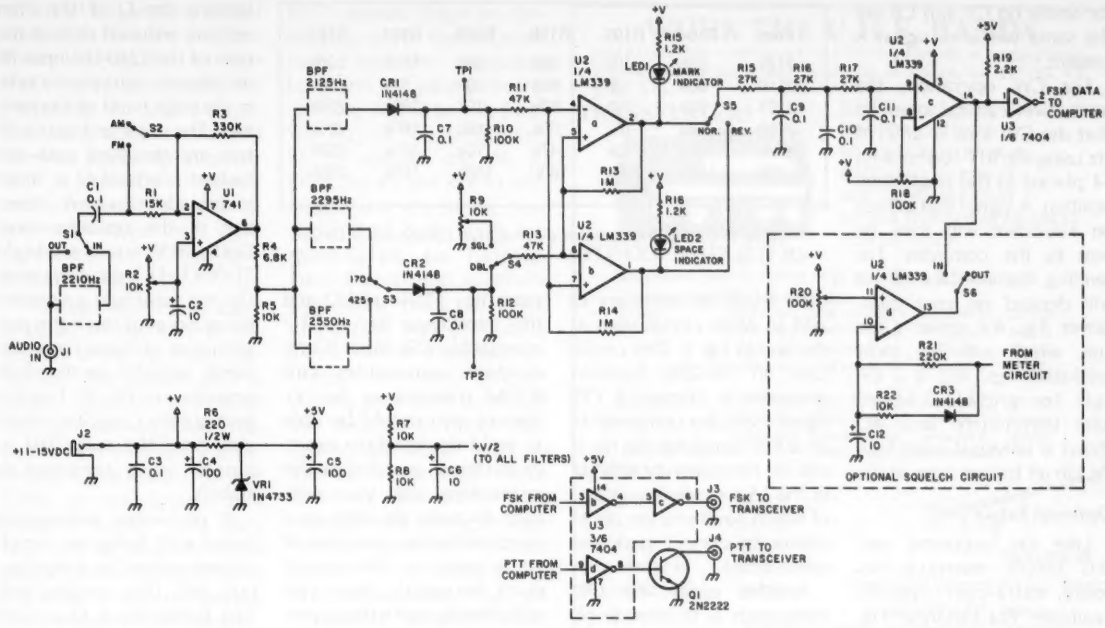


Fig.1. Computer interface.

is used mostly on VHF where signals are strong and clear, I would recommend using single-tone detection rather than adding another filter. A 2975-Hz BPF could be substituted for the 2550-Hz filter, or all three shifts could be implemented by using a three-position switch at S3. After the BPF stages, CR1 and CR2 half-wave rectify the output signals of the filters and, in conjunction with C7, C8, R10, and R12, provide dc levels corresponding to the strengths of the mark and space tones.

Two sections of U2, an LM339 quad comparator, are connected so that when the mark tone is present, the output of U2a goes low and U2b goes high. The presence of the space tone produces the opposite condition. The comparators will respond to relatively small differences in the detector dc levels, allowing for maximum signal-to-noise ratio. Since the difference between the levels of the two signals is detected rather than comparing each one to a set level, very weak and noisy signals can be decoded fairly accurately; i.e., the noise level coming out of each filter is assumed to be the same, so any difference must be due to the frequency changes in the FSK signal.

The outputs of U2a and U2b drive the LED mark and space indicators. S5 selects normal or reverse shift and sends the appropriate output to the three-pole passive post-detection filter consisting of R15–R17 and C9–C11. U2c squares the output of the filter and converts it to a TTL level, which is inverted by one section of a 7404 hex inverter, U3a. A TTL signal which is high on mark and low on space is now ready to be sent to the computer.

U3b and U3c simply buffer the computer FSK signal to be sent to the FSK input of the transceiver. U3d and Q1 provide a push-to-talk output so the computer can automatically switch the transceiver to the transmit mode.

The power supply requires a source of regulated dc power, typically 13.8 volts, which is available in most ham stations. Since the current required at 5 volts is very small, a simple zener-diode regulator is used. The voltage divider consisting of R7 and R8 provides a reference for all the active filter circuits. It is important that all the filters be supplied with the same reference because this ensures that the mark and space detec-

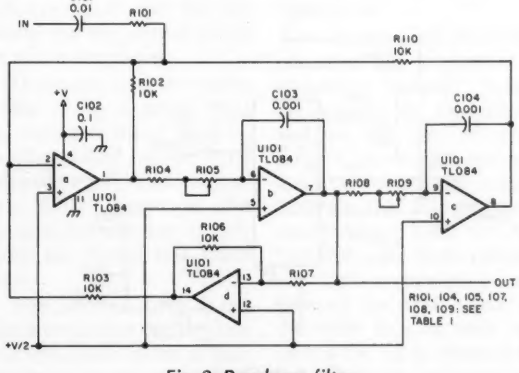


Fig. 2. Bandpass filter.

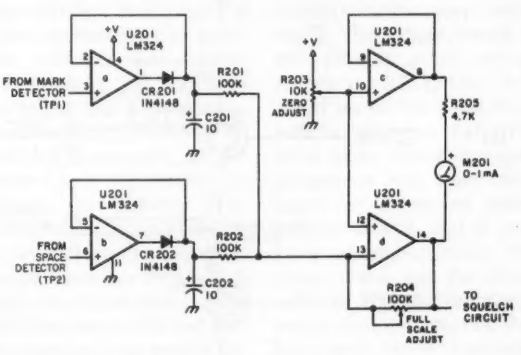


Fig. 3. Tuning indicator (optional).

tor levels on C7 and C8 are the same when no signal is present.

For CW operation, the transceiver can be tuned so that the CW tone is at 2125 Hz using the RIT control with S4 placed in the single-tone position. A signal that is high on key-down will then be sent to the computer. For sending, the interface circuit will depend on your transceiver. Fig. 4(a) shows a circuit which will key most solid-state rigs, 4(b) is a circuit for grid-block-keyed tube transmitters, and 4(c) shows a universal relay keying circuit for any type of rig.

Optional Extras

Like the economy car, this simple interface has some extra-cost options available. For instance, Fig. 3 shows a tuning-meter circuit using an LM324 quad op amp and a 0–1-mA meter which is very useful in making the fine-tuning adjustments required for accurate copy. It is very easy to use—just tune for maximum meter deflection and you are exactly on frequency. If you build the meter circuit, then adding a squelch to prevent on-screen "babbling" when tuning between signals is simple. The final section of the LM339 (U2d, Fig. 1) and a few extra components are all that is needed.

If your transceiver is not equipped for FSK operation, then it will be necessary to add an AFSK circuit such as the one in Fig. 5. This circuit uses an XR-2206 function generator to convert a TTL signal from the computer to an audio signal for the rig. It will be necessary to operate in the LSB mode (regardless of which band you are on) to obtain the correct mark and space tones.

Another option for CW enthusiasts is to provide filters in the 800-Hz range for the input and mark BPFs and suitable switching to select CW or RTTY. This is not included on the schematics because I felt it was not sufficiently important to warrant the increased complexity. Those who operate computer CW a lot may wish to do this, however. Table 1 lists component values for a tuning range of 650–950 Hz.

Freq	R104	R105	R108	R109	R101	R107
2125	68k	10k	68k	10k	160k	220k
2210	68k	10k	68k	10k	51k	68k
2295	62k	10k	62k	10k	160k	220k
2550	56k	10k	56k	10k	160k	220k
2975	47k	10k	47k	10k	160k	220k
800	160k	100k	160k	100k	160k	220k

Table 1. Component values for active bandpass filters.

Construction

Before beginning construction, you will have to investigate the manuals for your computer, the software you will be using with it, and your transceiver. If the computer has TTL-level I/O and the transceiver has a TTL-compatible FSK input (Commodore computers and ICOM transceivers, for instance), you should be able to build the interface exactly as shown. Just follow the instructions with your software to make the right connections to the computer. If some pieces of the puzzle don't fit exactly, then you will need to make the appropriate modifications. For instance, some computers have RS-232 I/O which will require level conversion to TTL. There seems to be some standardization among RTTY software programs as to polarities of input and output signals; however, this may not be true in all cases. Polarity conventions assumed here are: mark, high; space, low; key-down, high; PTT, low to transmit. As soon as you sort out all your polarities and levels, you are ready to start building.

Each block labeled BPF in Fig. 1 represents the active bandpass-filter circuit of Fig. 2. Each filter circuit is the same except for some resistor values which are listed in Table 1. R101 and R107 determine the Q of the filter and are reduced only in the case of the 2210-Hz input filter since it must pass a relatively wide band of frequencies. The mark and space filters are designed with the highest practical Q in order to provide maximum rejection of the opposite tone. Each BPF uses a single TL-084 bi-FET quad op amp. Do not substitute a conventional op amp since the performance of these filters depends partially on the characteristics of this IC. Use the best quality capacitors available for C103 and C104 to ensure good temperature stability.

A perforated prototyping board with holes on .1-inch centers makes for a neat layout and fast construction. The Radio Shack Dual Grid Board #276-161 is just the right size for this simple interface. Construction is not critical because operation is at audio frequencies. The TL-084s have a very high input impedance, so be careful to prevent stray coupling which could cause oscillation and ringing or reduce the effectiveness of the filter circuits. Use ferrite beads on all input and output leads and house the unit in a tight metal box to prevent rf from getting into the circuit. Shielded cables on all input and output lines including the cable to the computer are good practice, as well.

Alignment

When construction is completed you will need to

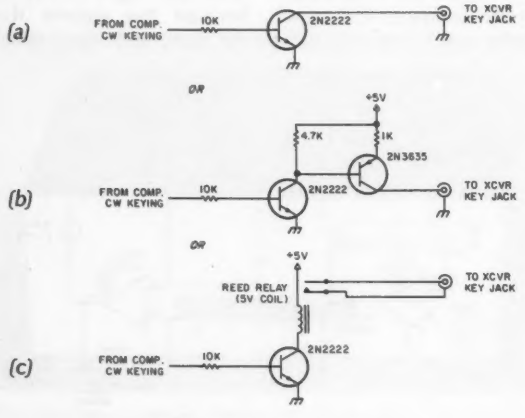


Fig. 4. CW keying circuits.

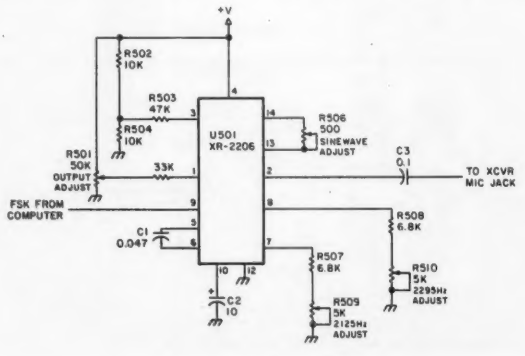


Fig. 5. AFSK circuit.

adjust all the pots for proper operation. How the unit performs will depend on how well the initial adjustments are made. To align the active filter circuits, you will need an audio signal generator or function generator and a frequency counter or an oscilloscope with very accurately calibrated horizontal sweep.

To align each filter, apply a signal of the correct frequency to the input and, observing the output with a scope, adjust R105 and R109 carefully for maximum output. If the frequency-determining capacitors, C103 and C104, are not close to their nominal values, you may find that the maximum output occurs at one extreme or the other of the pot's adjustment range. If this happens, it will be necessary to change the value of the resistor in series with the pot to the next higher or lower value. When you have peaked the filter to its center frequency, adjust the frequency control of the signal generator and observe that the output falls off rapidly and equally in both directions. You can now be assured that the filter is working correctly and will provide good performance.

Next, apply a sine wave of about 2 kHz to the audio input. With S1 in the OUT position and S2 in FM, increase the level until the output at pin 6 of U1 just becomes a square wave. Adjust R2 for the most symmetrical square wave possible. Change S2 to AM and observe that the output of U1 is now a sine wave.

If you are using the tuning meter of Fig. 3, adjust R203 to zero the meter with no audio applied and set R204 at mid-range. When adjusting R203, begin at the ground end and turn it only until the meter first reads zero.

You are now ready to put the interface on the air since the remainder of the adjustments are made with actual RTTY signals. Begin by connecting only the receiver audio and the computer. Load and run your software. Set S1 to IN, S2 to FM, S3 to 170 Hz, S4 to double-tone, S5 to normal, and S6 to OUT. Set R9 and R18 to mid-range. Tune in a strong clear signal until both mark and space LEDs are flashing. Tune the receiver carefully (preferably using a 10-Hz tuning rate) until the tuning meter reaches maximum deflection. Increase receiver volume until there is no further increase in meter indication and adjust R204 so that the meter reads about 80% of full scale. Print should be appearing on your screen. Adjust R18 in each direction until print begins to become garbled, then set it midway between these points. Switch to single-tone and adjust R9 so that copy is as good or nearly as good as it was. The adjustment of R18 is not critical on a good signal but becomes increasingly more so as signal quality worsens, so experiment a little with this control on poor signals before putting the lid on the box.

Now switch in the squelch and adjust R20 so that the squelch circuit does not interfere with normal copy but prevents any garbage from appearing on the screen when tuning between stations. Note that the squelch drops out quickly but takes a few seconds to pick up. It is normal for a few extraneous characters to be printed during the squelch tail.

If you are using the AFSK circuit of Fig. 5, connect a frequency counter and/or oscilloscope to the output and set all pots to mid-range. Ground pin 9 and adjust R510 for 2295 Hz; adjust R509 for 2125 Hz with pin 9 open. Adjust R506 for the best sine wave at the output. Set R501 to minimum and connect the AFSK signal to the mike jack of your rig; switch the rig to transmit in the LSB mode and leave the mike gain control in the usual position for phone operation. Increase R501 until you reach the output power you intend to use for RTTY operation.

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Operation

Now that the alignment is completed, all that remains is to make the final connections to your transceiver and put your computer on the air. Most of the operating instructions depend on the software that you are using. You will find that usually it won't be necessary to touch the interface—all control will be from the computer keyboard and the transceiver tuning dial. For ham RTTY and ASCII operation, set the interface controls as follows: FM, 170-Hz shift, double-tone, normal polarity, squelch in. These settings should work for 99% of all ham communications. Now and then you might find that someone is using reverse polarity. To copy a nonstandard shift or CW, switch to single-tone detection. The squelch must be switched out in this mode since it will never drop out on a single tone. The majority of commercial communications use 425-Hz shift and reverse polarity.

Now you can begin to enjoy keyboard operation. Whether you are a newcomer to this mode of operation or a RTTY old-timer, you will no doubt find exploring the world of computerized communication very interesting. This simple interface will provide good performance on RTTY, CW, and ASCII up to 110 baud. You will be able to chat with other hams, check into special-interest nets, leave messages for friends on radio bulletin boards, and if you have general-coverage receive, check out the press services, ship-to-shore communication, etc., outside the ham bands. Hope to see you soon on RTTY.■

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With this 16-channel telemetry encoder, you have a remote chance of finding out.

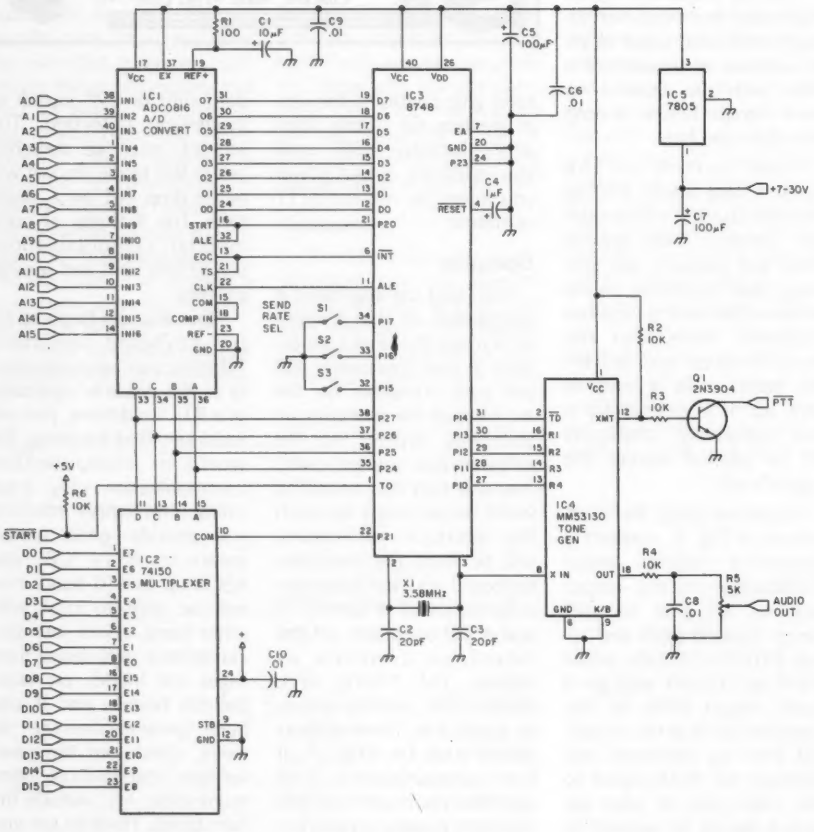


Fig. 1. Schematic.

Why go to all the trouble to downlink your repeater's telemetry at a speed and format that only a computer can handle? After all, most computers are not very portable. Modems and FSK generators can be expensive. Voice synthesizers tell your data to the world. Reading repeater parameters while mobile or portable can be exceedingly difficult.

This simple telemetry encoder will take a 6-millisecond "snapshot" of 16 analog and 16 digital channels and then downlink them as a series of high-speed touchtones™. When used with the touchtone data display that I described in the December, 1984, issue of *73* and a handie-talkie, you can have an inexpensive, secure system for readout of repeater parameters wherever you are.

Circuit Description

I like to keep circuits as simple as I can to minimize construction time. Therefore, I used an Intel 8748 mi-

```
0000                    0010 ***** TOUCHTONE TELEMETRY ENCODER ROUTINE *****
0000                    0020 **** BY ROBIN RUMBOLT WA4TEM 3/28/83 ****
0000                    0030        ORG   0
0000 15                 0040 START  DIS   I
0001 24 00              0050 XMIT   JMP   0100H
0003                    0060        ORG   100H
0100 35                 0070 XMT    DIS   TCNT       ; DISABLE TIMER INTERRUPT
0101 B8 20              0080        MOV   R0,#20H
0103 A5                 0090        CLR   F1
0104 B5                 0100        CPL   F1          ; SET FIRST TIME THRU FLAG
0105 27                 0110        CLR   A           ; INITIALIZE PORTS
0106 39                 0120        OUTL  P1,A
0107 3A                 0130        OUTL  P2,A
0108 AA                 0140        MOV   R2,A
0109 36 00              0150        JTO   XMT         ; WAIT FOR START LINE TO GO LOW
010B FA                 0160 REDAN  MOV   A,R2        ; BEGIN READING ANALOG DATA
010C 47                 0170        SWAP  A
010D 3A                 0180        OUTL  P2,A        ; OUTPUT CHANNEL ADR TO A/D
010E BA 01              0190        ORL   P2,#1H      ; GENERATE START PULSE
0110 9A FE              0200        ANL   P2,#0FEH
0112 BF 0F              0210        MOV   R7,#0FH     ; SET CHANNEL COUNTER
0114 EF 14              0220 HERE   DJNZ  R7,HERE     ; WAIT FOR A/D CONVERSION
0116 15                 0230 HERE2  DIS   I
0117 86 16              0240        JNI   HERE2       ; CHECK FOR END OF CONVERSION SIGNAL
0119 08                 0250        INS   A,BUS       ; READ IN DATA
011A A0                 0260        MOV   @R0,A       ; STORE IT
011B 18                 0270        INC   R0
011C 1A                 0280        INC   R2
011D FA                 0290        MOV   A,R2
011E 03 F0              0300        ADD   A,#0F0H
0120 C6 24              0310        JZ    DIG         ; CHECK FOR ALL ANALOG CHANNELS READ
0122 24 0B              0320        JMP   REDAN       ; IF NOT, GET NEXT CHANNEL
0124 27                 0330 DIG    CLR   A           ; GET READY TO READ DIGITAL CHANNELS
0125 AA                 0340        MOV   R2,A
0126 FA                 0350 REDIG  MOV   A,R2
0127 47                 0360        SWAP  A
0128 43 02              0370        ORL   A,#02H
012A 3A                 0380        OUTL  P2,A        ; OUTPUT DIGITAL CHANNEL ADR
012B F0                 0390        MOV   A,@R0
012C 97                 0400        CLR   C
012D F7                 0410        RLC   A
012E A0                 0420        MOV   @R0,A
012F 0A                 0430        IN    A,P2        ; INPUT CHANNEL DATA
0130 37                 0440        CPL   A           ; INVERT THE BIT
0131 53 02              0450        ANL   A,#02H
0133 97                 0460        CLR   C
0134 67                 0470        RRC   A           ; SHIFT IT IN TO DATA WORD
0135 40                 0480        ORL   A,@R0
0136 A0                 0490        MOV   @R0,A
0137 1A                 0500        INC   R2
0138 FA                 0510        MOV   A,R2
0139 03 F8              0520        ADD   A,#0F8H
013B C6 44              0530        JZ    NDIG        ;CHECK TO SEE IF BIT BELONGS IN SECOND DATA WORD
013D FA                 0540        MOV   A,R2
013E 03 F0              0550        ADD   A,#0F0H
0140 C6 47              0560        JZ    BGN         ; CHECK FOR ALL CHANNELS READ
0142 24 26              0570        JMP   REDIG       ;IF NOT, GET NEXT CHANNEL
0144 18                 0580 NDIG   INC   R0
0145 24 26              0590        JMP   REDIG
0147 B8 20              0600 BGN    MOV   R0,#20H
0149 BA 00              0610        MOV   R2,#0H      ;INITIALIZE REGISTERS
014B BF 12              0620        MOV   R7,#12H
014D FA                 0630 NV     MOV   A,R2        ;GET CHANNEL NUMBER
014E A8                 0640        MOV   R3,A
014F 34 80              0650        CALL  CONV        ;CONVERT TO BCD
0151 FD                 0660        MOV   A,R5
0152 53 F0              0670        ANL   A,#0F0H     ;PICK OUT FIRST DIGIT
0154 47                 0680        SWAP  A
0155 C6 59              0690        JZ    A1          ;IF IT IS ZERO DO NOT SEND IT
0157 34 B8              0700        CALL  OUTA        ;ELSE SEND IT
0159 FD                 0710 A1     MOV   A,R5
015A 53 0F              0720        ANL   A,#0FH      ;PICK OUT SECOND DIGIT
015C 34 B4              0730        CALL  OUT         ;SEND IT
015E 23 0C              0740        MOV   A,#0CH      ;SEND HYPHEN
0160 34 B4              0750        CALL  OUT
0162 F0                 0760        MOV   A,@R0       ; GET CHANNEL DATA
0163 18                 0770        INC   R0
0164 A8                 0780        MOV   R3,A
0165 34 B0              0790        CALL  CONV        ;CONVERT TO BCD
0167 FC                 0800        MOV   A,R4
0168 C6 6C              0810        JZ    E1          ; IGNORE LEADING ZERO
016A 34 B8              0820        CALL  OUTA
016C FD                 0830 B1     MOV   A,R5
016D 53 F0              0840        ANL   A,#0F0H
016F 47                 0850        SWAP  A
0170 34 B4              0860        CALL  OUT         ;SEND DIGIT
0172 FD                 0870        MOV   A,R5
0173 53 0F              0880        ANL   A,#0FH
0175 34 B4              0890        CALL  OUT         ;SEND NEXT DIGIT
0177 27                 0900        CLR   A
0178 34 B8              0910        CALL  OUTA        ;SEND A BLANK
017A 1A                 0920        INC   R2
017B EF 4D              0930        DJNZ  R7,NV
017D 24 00              0940        JMP   XMT         ; CHECK FOR ALL DATA SENT
017F 03 04              0950 ADT    ADD   A,#4H       ;ADD EXTRA TIME TO 1ST DIGIT SENT
0181 A5                 0960        CLR   F1
0182 24 96              0970        JMP   CON
0184 96 88              0980 OUT    JNZ   OUTA        ;TOUCHTONE OUTPUT ROUTINE
0186 23 0A              0990        MOV   A,#0AH
0188 43 10              1000 OUTA   ORL   A,#10H
018A 39                 1010        OUTL  P1,A
018B B9 E0              1020 DELAY  ORL   P1,#0E0H
018D 09                 1030        IN    A,P1        ;READ IN RATE SELECT SWITCH VALUE
018E 53 E0              1040        ANL   A,#0E0H
0190 47                 1050        SWAP  A
0191 77                 1060        RR    A
0192 03 02              1070        ADD   A,#2H
0194 76 7F              1080        JF1   ADT         ;CHECK FOR FIRST DIGIT DELAY
0196 AE                 1090 CON    MOV   R6,A
0197 23 3A              1100 GO     MOV   A,#3AH      ;SET ONBOARD TIMER FOR DELAY
0199 62                 1110        MOV   T,A
019A 55                 1120        STRT  T
019B 16 9F              1130 WAIT   JTF   NEXT        ; WAIT FOR TIMER OVERFLOW
019D 24 9B              1140        JMP   WAIT
019F EE 97              1150 NEXT   DJNZ  R6,GO
01A1 99 E0              1160        ANL   P1,#0E0H    ;KILL TONE OUTPUT
01A3 BE 02              1170        MOV   R6,#2H
01A5 23 3A              1180 GO2    MOV   A,#3AH      ; SET TIMER FOR OFF DELAY
01A7 62                 1190        MOV   T,A
01A8 55                 1200        STRT  T
01A9 16 AD              1210 WAIT2  JTF   NEXT2
01AB 24 A9              1220        JMP   WAIT2
01AD EE A5              1230 NEXT2  DJNZ  R6,GO2
01AF 93                 1240        RETR
01B0 27                 1250 CONV   CLR   A           ; BINARY TO BCD CONVERSION ROUTINE
01B1 AC                 1260        MOV   R4,A        ;TAKES BINARY VALUE FROM R3 AND PUTS
01B2 AD                 1270        MOV   R5,A        ;RESULTS IN R4 & R5
01B3 FB                 1280 S100   MOV   A,R3
01B4 03 9B              1290        ADD   A,#9BH
01B6 AB                 1300        MOV   R3,A
01B7 E6 BE              1310        JNC   A100
01B9 1C                 1320        INC   R4
01BA 17                 1330        INC   A
01BB AB                 1340        MOV   R3,A
01BC 24 B3              1350        JMP   S100
01BE FB                 1360 A100   MOV   A,R3
01BF 03 65              1370        ADD   A,#65H
01C1 AB                 1380        MOV   R3,A
01C2 FB                 1390 S10    MOV   A,R3
01C3 03 F6              1400        ADD   A,#0F6H
01C5 AB                 1410        MOV   R3,A
01C6 F2 CB              1420        JB    7,AD10
01C8 1D                 1430        INC   R5
01C9 24 C2              1440        JMP   S10
01CB FB                 1450 AD10   MOV   A,R3
01CC 03 0A              1460        ADD   A,#0AH
01CE AB                 1470        MOV   R3,A
01CF FD                 1480        MOV   A,R5
01D0 47                 1490        SWAP  A
01D1 68                 1500        ADD   A,R3
01D2 AD                 1510        MOV   R5,A
01D3 93                 1520        RETR
SYMBOL TABLE
A1   0159  A100  01BE  AD10  01CB  ADT   017F  B1   016C
BGN  0147  CON   0196  CONV  01B0  DELAY 018B  DIG  0124
GO   0197  GO2   01A5  HERE  0114  HERE2 0116  NDIG 0144
NEXT 019F  NEXT2 01AD  NV    014D  OUT   0184  OUTA 0188
REDAN 010B REDIG 0126  S10   01C2  S100  01B3  START 0000
WAIT 0198  WAIT2 01A9  XMIT  0001  XMT   0100
```

Fig. 2. Program listing.

croprocessor to simplify the circuitry. The circuit shown in Fig. 1 uses only 5 ICs, if you count the voltage regulator.

IC1, a National ADC0816, is an 8-bit A/D converter combined with a 16-channel multiplexer. Given a channel address, a start pulse, and some clock pulses, this converter can do a complete conversion in just a few microseconds. The ADC0816 has an on-board analog multiplexer which eliminates the need for an external multiplexer. This multiplexer connects one of its 16 input lines to the input of the A/D converter, depending on which input is addressed by the microprocessor.

IC2, a 74150 16-bit multiplexer, does the same job as IC1, except that it does it for digital signals. A 74C150 would be a better choice for this spot (since it is CMOS and therefore has a much lower current drain), but I didn't have one, so I just plugged in the regular TTL version instead. If you have a 74C150, you can just substitute it since the two ICs are pin compatible.

The 8748 microprocessor, IC3, controls the whole show. It addresses and operates the A/D converter, the digital multiplexer, and the touchtone generator. It receives data, converts it to the proper format, and then outputs it at the switch-selected rate.

The National MM53130 touchtone generator, IC4, not only generates the standard 16-digit tone pairs, but it also outputs a push-to-talk signal for keying the downlink transmitter. This PTT signal is only present while the tone is on, however. So, if you do not want your transmitter to drop out between tones, you might

Parts List

1	R1	Resistor, 100 Ohms, ¼ W, 20%	$ .06
4	R2–R4, R6	Resistor, 10k Ohms, ¼ W, 20%	.24
1	R5	Trimpot, 5k Ohms, ¼ W, 20%	.59
1	C1	Capacitor, 10 μF, 16 V, electrolytic	.49
2	C2–C3	Capacitor, 20 pF, 50 V, disc ceramic	.39
1	C4	Capacitor, 1 μF, 16 V, electrolytic	.49
2	C5, C7	Capacitor, 100 μF, 35 V, electrolytic	1.58
4	C6, C8–C10	Capacitor, .01 μF, 50 V, disc ceramic	.32
1	Q1	Transistor, 2N3904 NPN or equivalent	.30
1	IC1	IC, ADC0816 A/D converter	9.95
1	IC2	IC, 74150 16-line multiplexer	1.35
1	IC3	8748 microprocessor (see text)	50.00
1	IC4	IC, MM53130 DTMF encoder	5.95
1	IC5	IC, LM7805 5-V regulator	1.59
1	X1	Crystal, 3.579 MHz, TV burst	1.99
2	———	40-pin IC socket	.98
1	———	24-pin IC socket	.33
1	———	18-pin IC socket	.24
1	S1–S3	3- or 4-position DIP switch	1.19
1	———	PC board (see text)	10.00

want to add a small delay circuit. The one advantage that the MM53130 has over other touchtone generator chips is that it will accept either 2-of-8-type inputs *or* standard 4-line binary inputs. Other generator ICs accept only the 2-of-8-style inputs.

Lastly, a 7805 three-terminal, 5-volt regulator is used to supply a constant voltage for the entire circuit.

Software

The microprocessor program that runs the telemetry encoder is shown in Fig. 2. Since it is commented fairly well, I'll just briefly outline it here:

Lines 40–60 direct the microprocessor to the transmit program located at address 100 hex. I put the transmit-routine start point at that location in order to make room for the data-display routine that was described in the previous article. Neither program is very long, so I put them both in memory simultaneously. That way I could easily swap the processor from one circuit to another. When the microprocessor first wakes up or is reset, it immediately goes to location 0 for its first instruction. That is why I put the vector there.

Lines 70–150 form the instruction loop that the processor stays in until the start line is grounded. When that happens, the processor begins executing lines 160–590, which comprise the part of the program that reads all the analog and digital channel values and stores them in memory.

Once the data is all gathered, it must be formatted and sent out to the touchtone generator. Lines 600–940 take care of these chores.

Program instructions at lines 950–1240 form the OUTput subroutine which routes the data to the touchtone generator and ensures proper pulse durations.

The CONVert subroutine, lines 1250–1520, performs a binary-to-BCD conversion on all channel numbers and

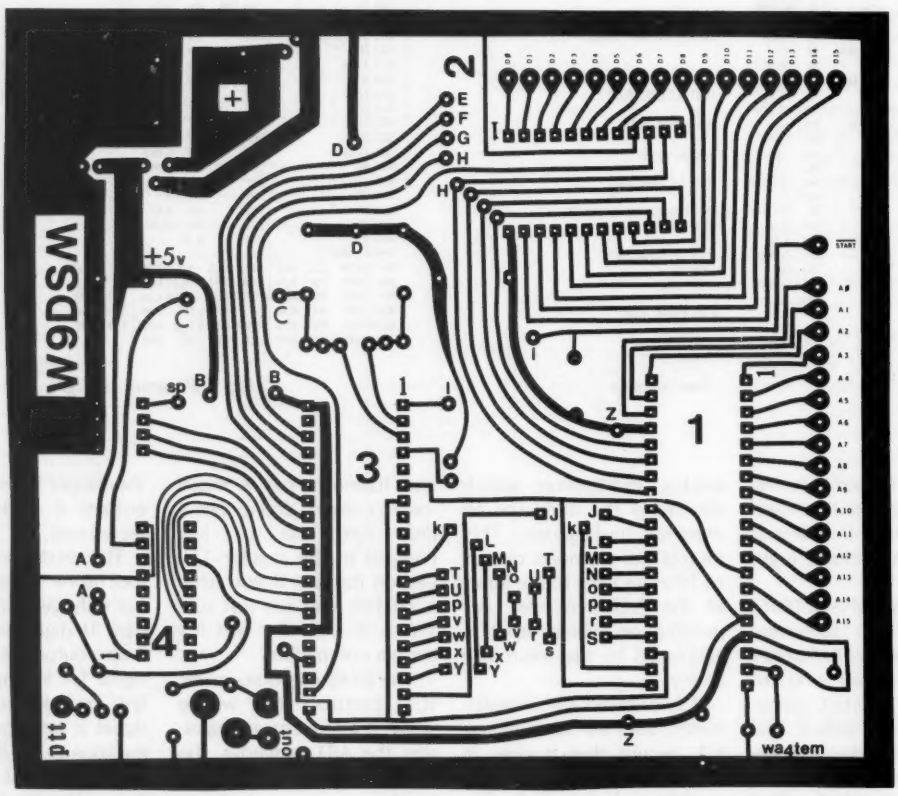
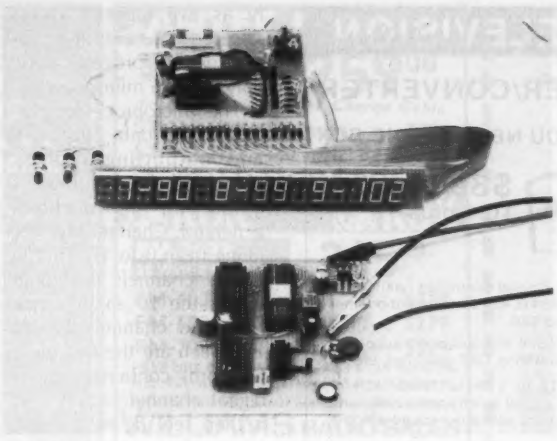


Fig. 3. PC board, foil side.

data. I convert all numbers to BCD instead of sending them out in hex format because the touchtone generator can only generate 16 tone pairs and the display unit uses three of those for special symbols. That doesn't leave enough characters to represent the hex characters 0–9 and A–F. So I had to send everything in BCD.

Construction

A printed circuit board was developed for this circuit and is shown in Fig. 3. The parts-placement diagram is shown in Fig. 4. Due to the relatively large number of lines needed to interconnect the ICs, about 25 jumpers were needed on the board. These could have been eliminated by using a double-sided PC board, but that would have made the board much harder to duplicate. The jumpers are all designated by single letters A–Z. Simply connect points labeled with the same letter: A to A, B to B, C to C, etc. I recommend that all parts be installed on the board before wiring the jumpers, except for jumpers E through H. These jumpers are very close to the end of IC2 and might be more easily installed before the IC socket is soldered on. Note that in this group only jumper H is labeled on both ends. This is due to the fact that there just wasn't room to put labels on the board. These few jumpers are short and are shown on the parts-placement diagram. Also note that jumper Q is not labeled on the board, but it is shown on the parts-placement drawing (near pin 25 of IC3).



Touchtone telemetry encoder prototype shown with data display unit.

Two sets of holes have been provided for crystal X1, a TV color-burst crystal. This is to allow easy use of either the large or small style of burst crystal.

The regulator, IC5, should

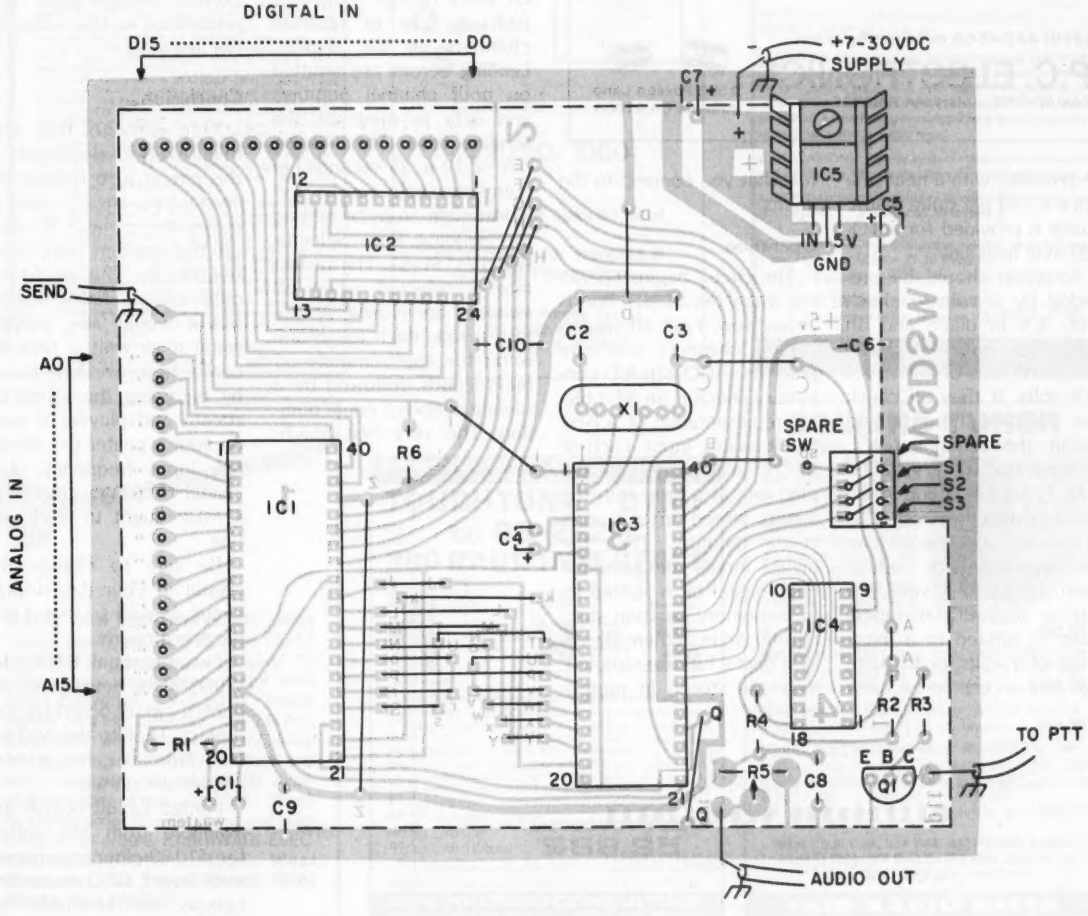


Fig. 4. Parts placement.

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be provided with a heat sink since it can get quite warm. Space is provided for a TO-220-style heat sink.

Power-up should be preceded by a voltage check with IC5 in place and all other ICs removed. Check the power pins of all ICs for +5 volts. If they all check out, disconnect power and install the remaining ICs. Observe that IC4 is installed with its pin 1 pointing in the opposite direction from IC3.

Although this circuit can be powered by any voltage from about 6 to 30 volts, the analog and digital inputs must be limited to a maximum of 5 volts (or IC damage can occur). So be careful what you connect to the inputs.

Operation

The circuit begins operating when the START line is pulsed low. First, all sixteen analog channels are sampled. The ADC0816 A/D converter generates an 8-bit digital representation of a 0-to-5-volt analog input. Each of the 16 analog inputs is sampled one at a time with the results stored in microprocessor memory. Then the digital inputs are sampled. Each digital bit is shifted into a memory location shift-register style. When all sixteen digital bits are sampled, they are stored in memory as two eight-bit words. The entire sampling and conversion process takes only about 6 milliseconds.

The microprocessor then begins the data formatting and outputting process. First, a channel number is output to the touchtone generator. Channel numbers range from 0 to 17. That includes channels 0 through 15 for the 16 analog channels, and channels 16 and 17, which are the two eight-bit words containing the 16 digital channel bits. A "−" is then sent (# on a touchtone pad) to serve as a separator between channel number and data. Next, the channel's data is retrieved from memory and converted to a three-digit BCD number ranging from 0 to 255. Then these three digits are sent. Lastly, a space (D on most 16-digit touchtone pads) is sent to separate channels on the display. Leading zeroes are omitted on both channel numbers and data to minimize the sending time. The sending rate of 12 to 25 seconds per complete cycle can be varied in eight steps by setting the Sending Rate Selector switches, S1–S3. The fastest rate is selected when all switches are closed. At the fastest rate, each touchtone is on for approximately 35 milliseconds, followed by a silence period of equal duration. The very first touchtone sent in a cycle (channel 0) is held on slightly longer to allow transmitters and receivers in the downlink system to come alive. The resulting format and timing of all this outputting is shown in Fig. 5.

To easily interpret the displayed analog data received on the downlink, I made use of a simple nomograph shown in Fig. 6. Numbers from 0 to 255 are scaled along one side of the vertical line. Numbers representing whatever data is to be measured can be put on the left side of the line. For example, if you are measuring temperature, a scale from −40 to +150 degrees may be drawn on the left of the line. Then if the downlinked data reads 182, you can simply find 182 on the right side of the line and read the correct temperature corresponding to that value on the left side.

Conclusion

One change that you might wish to incorporate in this circuit is to change the crystal frequency in order to move the generated tones off the standard touchtone frequencies. This would not only ensure link security, but it would also prevent some idiot with a tape recorder from wreaking havoc by recording the telemetry stream and playing it back on your repeater or control-link input frequency. Any crystal frequency from 1 to 4 MHz ought to work just fine.

Be sure to change the crystal in your data-display circuit as well so that it will decode properly.

I want to thank Bill Kaylor W9DSM for developing the printed circuit board for this project. Thanks also to Paul Hamilton for his photographic assistance.

Printed circuit boards are available from the author for $10.00. Preprogrammed and tested 8748 microprocessors are available for $50.00. ■

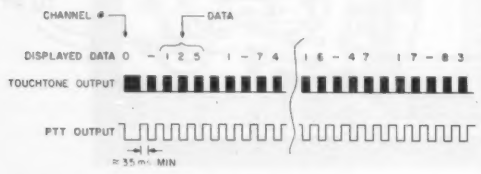

Fig. 5. Timing diagram.

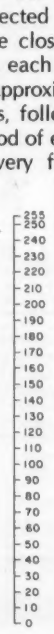

Fig. 6. Nomograph.

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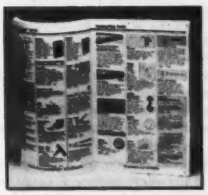

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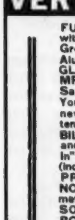

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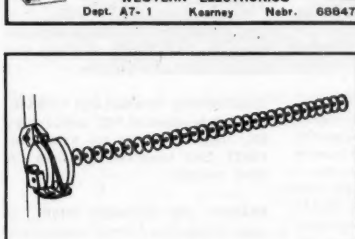

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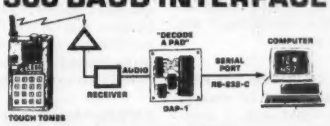

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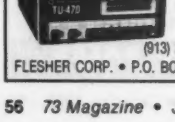

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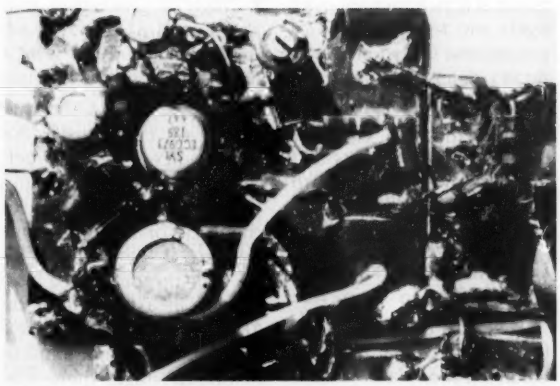

Photo A. Close-up of balanced modulator showing X-acto® - knife "cut and slash" construction technique.

This would be a good evening for a test, I thought. Several conversations drifted through the speaker as I glided along the bottom of the six-meter phone band. There was a strong summer E opening to the south. "Well, here goes," I said, and I let out a CQ. I had just finished building the transceiver that afternoon and, although its transmitter is only half a Watt, by the end of the opening it had netted ten states and a Caribbean island. I had faith in my simplistic design, but this performance was even better than I had expected.

This is an article on how to construct a six-meter sideband transceiver. I originally planned to write it in a concise, technical manner, when a non-ham friend's observation made me re-

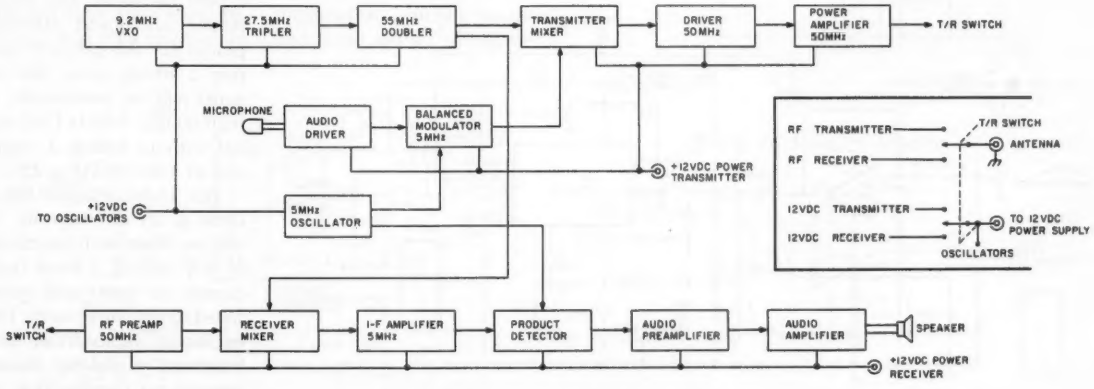

Fig. 1. Block diagram of a 50-MHz transceiver.

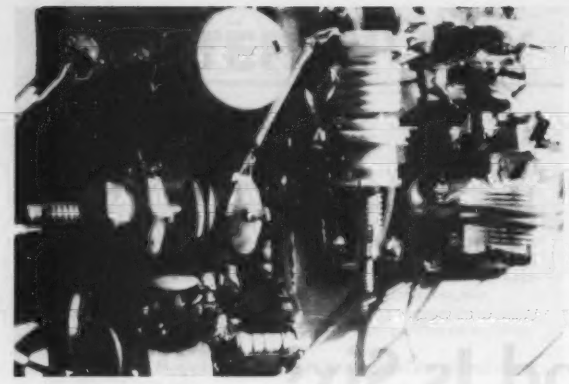

Photo B. Close-up of receiver mixer stage showing detail of coil windings found throughout the transceiver.

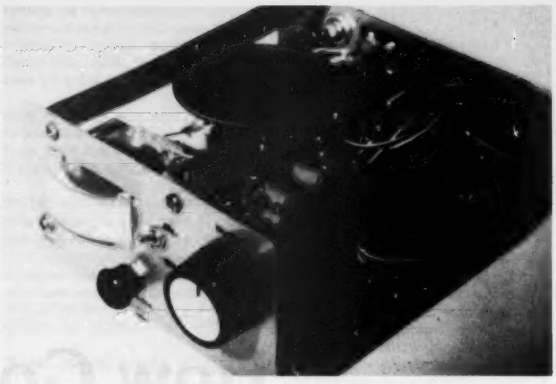

Photo C. Completed 6m DSB transceiver.

think my approach. After looking over the completed schematic, her comment was, "I wouldn't know where to begin building *that*!" I realized something forgotten years ago: It is awful to have the desire to build when you think you lack the technical skills.

Reassurance

The truth is that if you can get a one- or two-transistor project to work, then working with ten times that number of transistors really isn't any more difficult. It requires going step by step and making sure everything is correct before proceeding. In the end the pieces will all slide into place. It is this step-by-step approach I've taken with this transceiver. It is easy to become overwhelmed, so look only at each circuit stage. When it is all together, you appreciate the complexity. In the end you say, "I built that!"

Theory

The transceiver has a 5-MHz crystal oscillator that is used both for DSB generation in the transmitter and for bfo injection for the direct-conversion receiver. A second crystal oscillator is variable (vxo) and injects, after multiplication, 55 MHz into the mixers for both the transmitter and the receiver. Since both of these sections of the transceiver share the same oscillators, they are locked to each other in frequency. What you hear is where you talk, so to speak. This arrangement means never having to worry about being off frequency. To keep the transmitter simple it operates DSB.

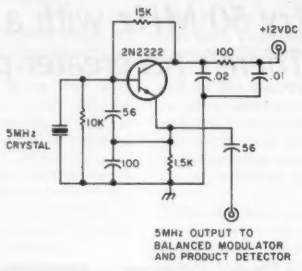

Fig. 3. 5-MHz Colpitts oscillator.

While this is a six-meter transceiver, the circuits and theory can be applied to other frequencies, but this will become obvious later on. See Fig. 1.

DSB Generation

The heart of the transmitter is a Sylvania ECG-973 balanced modulator. This is truly an amazing device. With no tuned circuits and a handful of fixed-value parts, you can construct a DSB source exhibiting better than a 50-dB carrier suppression. I especially like the lack of tuned circuits because it eliminates a lot of tune-up problems. I've used it in a transmitter on 185 kHz, and with the exception of the final amplifier output stage, there was nothing except the carrier balance to tune!

The balanced modulator, 5-MHz oscillator, and audio driver are good starting places for this project. Barring a wiring error, the reward will be immediate: a high-quality 5-MHz DSB signal without tuning a single coil or capacitor (Fig. 2).

The 5-MHz Colpitts oscillator is an old favorite. It will oscillate with practically any crystal. I have built dozens of them and never failed to get one to work. The oscillator, audio driver, and balanced modulator should present no construction or tune-up difficulties. A field-

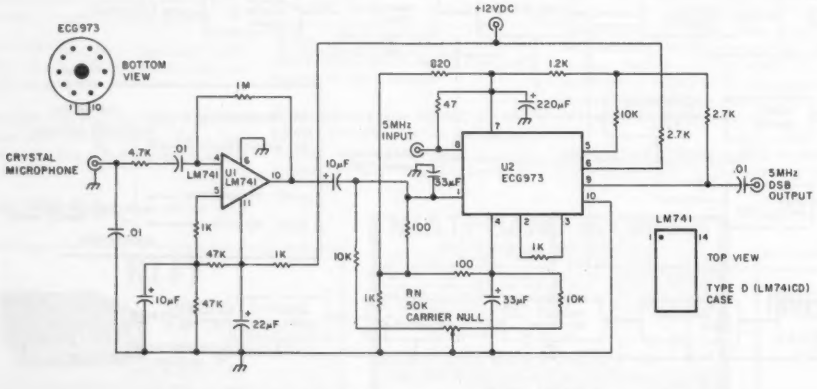

Fig. 2. Audio driver, balanced modulator.

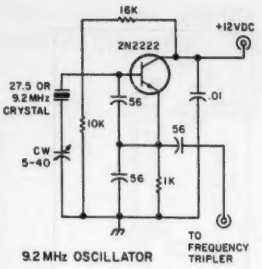

Fig. 4. 9.2-MHz vxo.

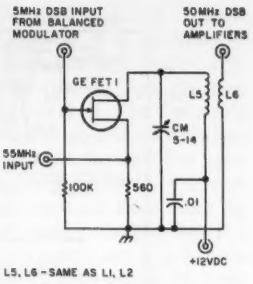

Fig. 7. Transmitting mixer.

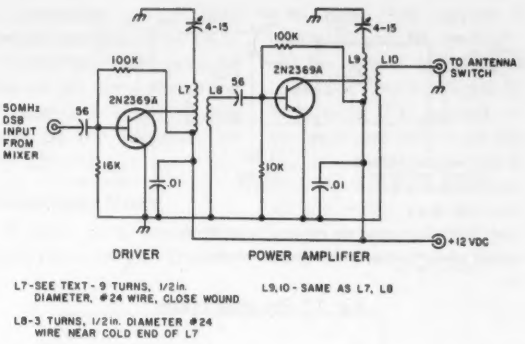

Fig. 8. Driver/power amplifier.

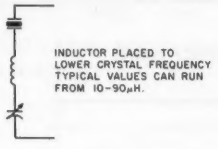

Fig. 5.

strength meter (FSM) can be used to verify both the oscillator output and the DSB coming from the ECG-973. This just about guarantees that everything is right. A double check by listening on 5 MHz will be especially rewarding as you tune through a superbly clean, crisp sideband signal. Only a slight adjustment to R_N will be necessary to null the carrier to better than 50 dB.

At this point some may ask, "Why not filter the DSB and make SSB?" You can, I have, and it works. If you have a crystal filter and change the mixing frequencies accordingly, this will produce a fine SSB generator. Personally I have found almost universal acceptance of DSB on VHF. Most stations have such sharp receivers that they never even detect the other sideband. So unless you tell then you are operating DSB, they will never know. Building crystal filters can be an enlightening (tricky) business, and DSB is so much easier. Why fight?

Construction

The balanced modulator as well as all the other circuits are built on copper-clad glass-epoxy boards. I have learned that it is easier to build and test one stage at a time before proceeding on. Therefore, each circuit section is an individual square of PC board. Revisions occur all too frequently before arriving at a final circuit. This happens even when following a design that is known and proven. I recommend buying the best quality boards available because there is nothing more frustrating than having the copper foil peel away from the cheap PC board which has been heated once too often.

Each circuit section is approximately 2 inches square and these are wired together. Rather than elaborately planning out the wiring routes and component placements as required when etching PC boards, I use an X-acto® knife to cut away the copper foil and establish isolated islands to solder to. The effect isn't much to look at but it is quick, effective, and easily modified.

Vxo and Frequency Multipliers

This variable crystal oscillator (Fig. 4) exacts a cost but returns certain valuable benefits. The cost is the loss of band coverage as compared to a vfo; the benefits are extreme frequency stability when compared to that same vfo. This vxo also uses a Colpitts oscillator, operating at 9.2 MHz. This is multiplied six times to 55 MHz, which then feeds both the transmitter and receiver mixers. At 9 MHz the oscillator's frequency can be warped about ±6 to 9 kHz by C_W. This comes out to a 40-to-60-kHz swing at 50 MHz.

My own unit operates between 50.105 and 50.160 MHz. The addition of more crystals would mean greater frequency coverage. The nice thing about the vxo is its stability. From a cold

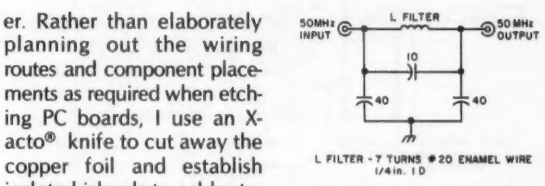

Fig. 9. Transmitting TVI filter.

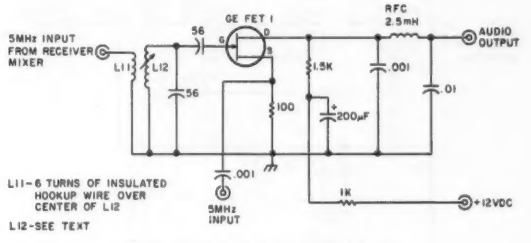

Fig. 10. Product detector.

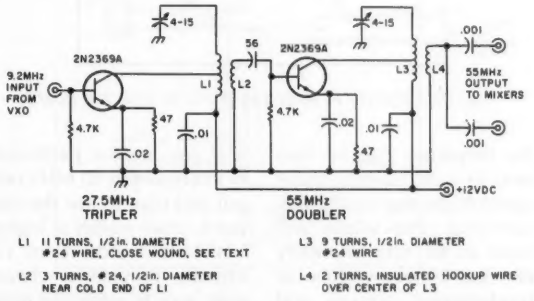

Fig. 6. 9.2-to55-MHz doubler/tripler.

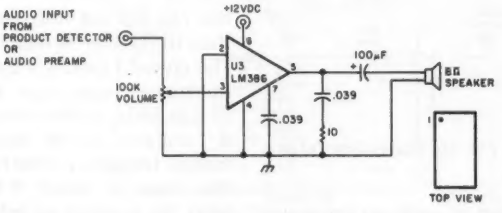

Fig. 11. Audio amplifier.

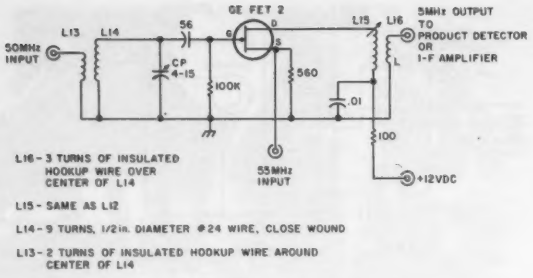

Fig. 12. Receiver mixer.

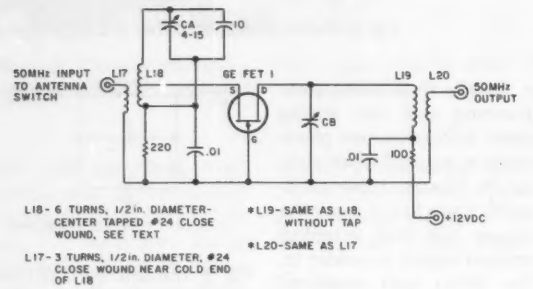

Fig. 13. Rf receiver preamp.

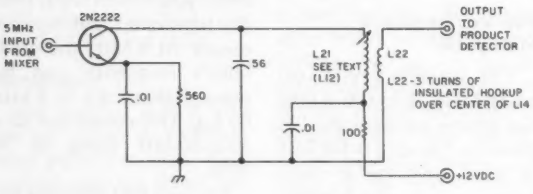

Fig. 14. I-f amplifier.

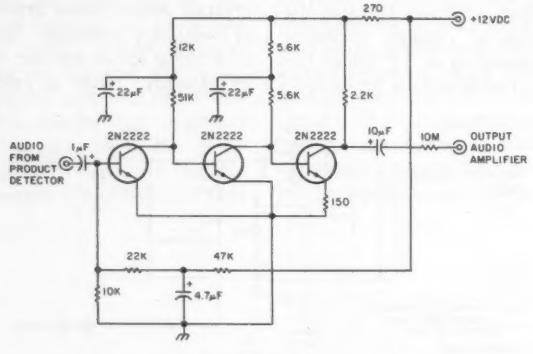

Fig. 15. Receiver audio amplifier.

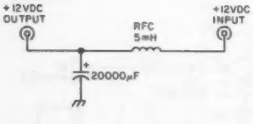

Fig. 16. Power-line filter.

start-up using an unregulated power supply for a test, the vxo did not drift more than 10 Hz over 90 minutes. The crystal I used is a third-overtone type, cut for 27.530 MHz. In this circuit it oscillates on its fundamental frequency, which in this case is about 9.185 MHz. By inserting an inductor (Fig. 5) in series with C_W, the frequency can be lowered to more closely correspond to the true crystal fundamental. The values will have to be experimentally derived. Either overtone or fundamental crystals will work fine in this circuit.

If you are not particularly interested in 50 MHz output and plan to use the output to drive mixers at higher VHF/UHF bands, then CB crystals provide a cheap, easy way to generate rock-stable signals.

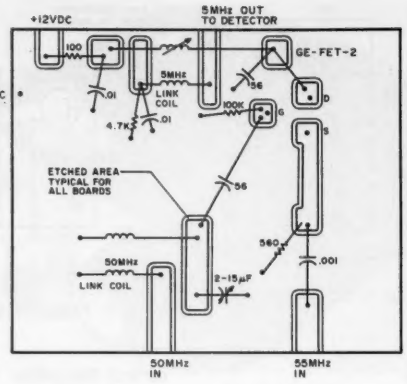

Fig. 17. Receiver mixer board.

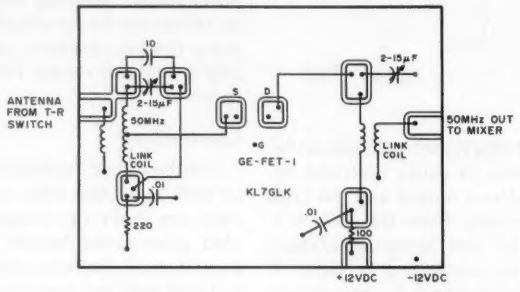

Fig. 18. Receiver rf preamp board.

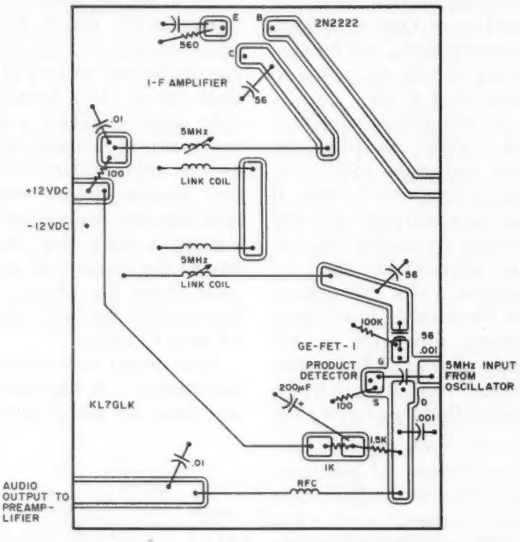

Fig. 19. Receiver i-f amp and product detector board.

It is not until the first multiplier that we reach the first tuned circuits. A grid-dip meter and a frequency counter will ensure 27.5 MHz coming from the tripler in Fig. 6. The following doubler should be checked also to make sure it is passing only 55 MHz. The output coils of these and all the other stages of the transceiver are ½-inch-diameter mini-ductor, 36 turns to the inch. They can be wound freehand if desired. In either case the linking coils are placed near the cold (capacitor-bypassed) end of the tank coil. The tuning capacitors are all Johnson air variables, type T-6-5.

These are nice because they solder vertically to the PC board. I seem to use them by the handfuls for VHF circuits.

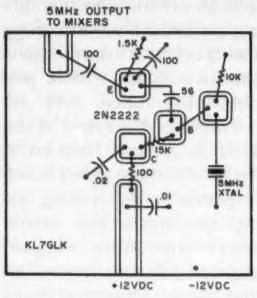

Fig. 20. 5-MHz crystal-oscillator board.

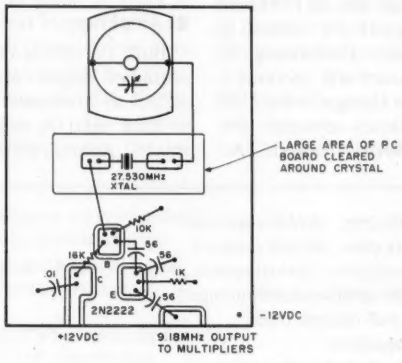

Fig. 21. 9.18-MHz vxo board.

Transmitting Mixer

If there is a transmitter stage that can give trouble, it is here. The circuit is straightforward enough, but be careful in tuning it up. Make sure it is 5 and 55 MHz only that appear on the gate and source of the FET and that L_5 is tuned to 50 MHz. Tuning up a transmitting mixer can be confusing because of the presence of the local-oscillator

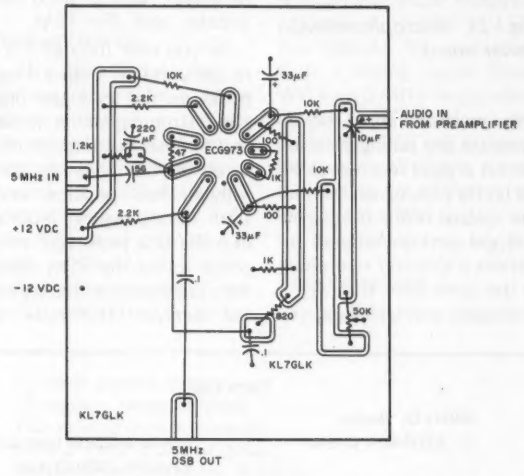

Fig. 23. Transmitter balanced-modulator board.

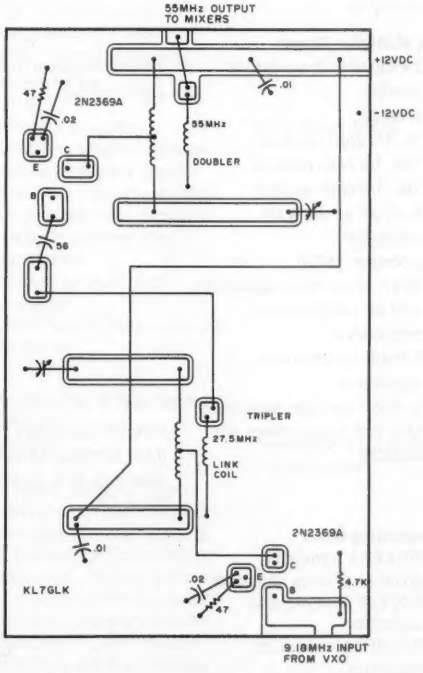

Fig. 22. 9-to-55-MHz multiplier board.

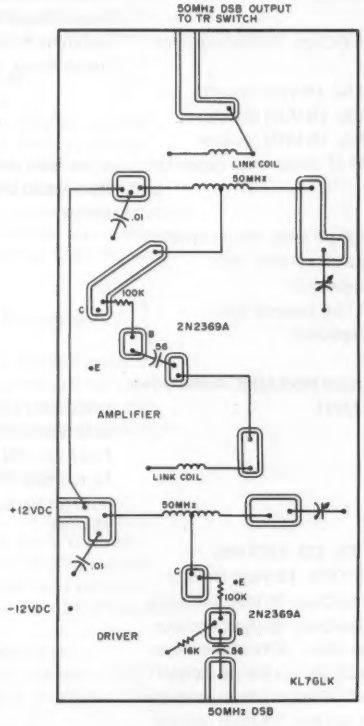

Fig. 24. Transmitter driver and amplifier board.

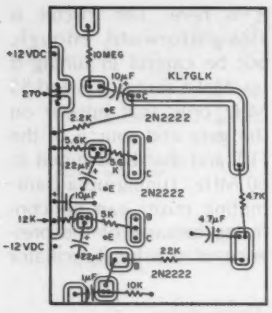

Fig. 25. Microphone/audio driver board.

frequencies. A simple way to optimize the tuning is to listen on a good receiver at 50 MHz. By placing an FSM at the output of the mixer you will get an educational experience in mixer operation at the same time. (Fig. 7).

Attach a microphone to the audio driver but place it so that it will pick up only a minimum of sounds (insulate it by wrapping it in a piece of cloth, etc.). What you want is a low-level white-noise-modulated DSB signal entering the mixer. The mixer stage tunes roughly 45 to 65 MHz so start at the fully-meshed position of C_M. Listen to the receiver, watch both its S-meter and the FSM.

As you tune through C_M's range, you may notice three peaks on the FSM and one good strong peak in noise and S-meter reading on the receiver. Go back to the fully-meshed position and start tuning again. Notice that the first peak you may come to on the FSM does not correspond to a peak on the receiver. This peak is more than likely a weird combination of mixer products, or a fifth harmonic of the vxo. In any case it is not what is wanted. Touch up the tuning on the output stage of the doubler and tripler to minimize this as much as possible, but not to the extent of changing the injection from 55 MHz.

Go on tuning C_M upward until you find an even peak in the receiver S-meter and noise. This is 50 MHz. Notice that the FSM reading has not changed much. There is a lot of rf activity going on inside the mixer. As you can see, an FSM isn't much good for adjusting this stage. Continuing to tune upward will produce a dramatic change in the FSM as it passes through the vxo's 55-MHz output. All this should go to show why it is not a good idea to use a transmitting mixer directly into an antenna. In this tuning procedure we are using the receiver as a selective, sensitive filter which permits observation and adjustment of the mixer at the desired output frequency. An FSM, on the other hand, responds to everything going on inside the mixer. There are more elegant ways to adjust a mixer, but they require expensive equipment and they may not be as sensitive as this simple technique.

Rf Amplifiers

Both the driver and final amplifier stages can be adjusted in a manner similar to that used to adjust the mixer. Again, using only

Parts List

5-MHz Oscillator

1	5.000-MHz crystal	crystal available from Jan Crystals, 2400 Crystal Drive, PO Box 06017, Fort Myers FL 33906
1	2N2222	transistor available from Radio Shack stores
1	100-Ohm, 1/8-Watt resistor	resistors available from Radio Shack stores.
1	1.5k, 1/8-Watt resistor	
1	10k, 1/8-Watt resistor	
1	15k, 1/8-Watt resistor	
1	56-pF silver mica capacitor	capacitors available from Radio Shack stores
1	100-pF silver mica capacitor	
1	0.2-uF ceramic disc capacitor	
1	0.1-uF ceramic disc capacitor	

Balanced Modulator, Audio Driver

1	LM741	Intergrated circuits available from BCD Radio Parts Co., PO Box 119, Richardson TX 75080-0020 (or Radio Shack for 741-386)
1	ECG 973 (MC1496)	
1	47-Ohm, 1/8-Watt resistor	
2	100-Ohm, 1/8-Watt resistors	
1	820-Ohm, 1/8-Watt resistor	
4	1k-Ohm, 1/8-Watt resistors	
1	1.2k-Ohm, 1/8-watt resistor	
2	2.7k-Ohm, 1/8-Watt resistors	
1	4.7k-Ohm, 1/8-Watt resistor	
3	10k-Ohm, 1/8-Watt resistors	
2	47k-Ohm, 1/8-Watt resistors	
1	1-megohm, 1/8-Watt resistor	
1	50k variable resistor (trimpot)	
4	0.1-uF ceramic disc capacitors	
2	10-uF electrolytic capacitors, 15 WV dc	
1	22-uF electrolytic capacitors, 15 WV dc	

Vxo, Multiplier Stages

1	27.530-MHz 3rd-overtone crystal	crystal available from Jan Crystals
1	2N2222	
1	1k, 1/8-Watt resistor	
1	10k, 1/8-Watt resistor	
1	16k, 1/8-Watt resistor	
1	2-25-pF air variable capacitor (Johnson 157-3)	
3	56-pF silver mica capacitors	
2	0.02-uF ceramic disc capacitors	
2	0.01-uF ceramic disc capacitors	
2	2-15-pF variable capacitors (Johnson T-6-5) others are suitable	variable capacitors (Mini-Trimmer #3) available from BCL Radio Parts Co.

Transmitting Mixer

1	GE-FET-1 transistor	
1	56-pF siver mica capacitor	
1	0.001-uF ceramic disc capacitor	
1	0.01-uF ceramic disc capacitor	

white noise into the balanced modulator, these stages are adjusted for maximum output by listening on 50 MHz. This technique allows us to select against any mixer outputs except 50 MHz. Once this is accomplished, an FSM and pilot-lamp bulb across L10 will show output only when you speak into the microphone. Both the driver and final tank coils are fairly selective against passing any 55-MHz energy to the antenna. Once the radio is properly shielded and bypassed, I can get away without a TVI filter. A filter is still a good idea and I've included a simple low-pass design just in case (Fig. 9).

The final amplifier shows no resistor in the emitter lead. Without one, the input power is about half a Watt. By inserting a variable resistor here the input can be varied down to a few milliwatts for those who like real QRP.

Receiver

This receiver's design allows a certain amount of flexibility in its construction. It can be kept simple or expanded as the builder desires. Basically it is an rf amplifier, a mixer, a product detector, and an audio amplifier. 55 MHz mixes with 50; the difference—5 MHz is directly converted to audio by mixing with 5 MHz in the product detector. The audio is then amplified.

Having grown up with the idea that good receivers are supposed to be complex, I still find it difficult to believe anything this simple can work so well.

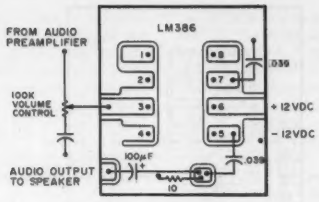

Fig. 26. Receiver audio preamp board.

Product Detector

A product detector is nothing more than a mixer whose output is in the audio range (Fig. 10). L12 is 50 turns of #30 enamel wire, wound on a 3/8-inch-diameter iron-slug-tuned coil. The tune-up of this stage is easy; adjust L12 to 5 MHz with a grid-dip meter. If the audio amplifier (we are stepping ahead a little here) is attached and a longwire antenna is hooked to L11, you should be rewarded with a strong signal from WWV on 5 MHz. Notice that if your oscillator is exactly on 5 MHz, you will hear no beat note with WWV. If not, the frequency difference in Hz (or kHz) will appear as the heterodyne frequency.

Audio Amplifier

You will notice I skipped

1 560-Ohm, 1/8-Watt resistor
1 100k, 1/8-Watt resistor

Drivers and Power Amplifier

2 2N2369A transistors — from BCD Radio Parts Co.
2 56-pF silver mica capacitors
2 0.01-uF ceramic disc capacitors
2 2–15-pF air variable capacitors
1 10k, 1/8-Watt resistor
1 16k, 1/8-Watt resistor
2 100k, 1/8-Watt resistors

Product detector

1 GE-FET-1
1 2.5-mH rfc (choke) — from Radio Shack
1 100-Ohm, 1/8-Watt resistor
1 1k-Ohm, 1/8-Watt resistor
1 1.5k-Ohm, 1/8 Watt resistor
1 56-pF silver mica capacitor
2 0.001-uF ceramic disc capacitors
1 0.01-uF ceramic disc capacitor
1 200-uF electrolytic capacitor 15 WV dc

Audio Amplifier & Preamplifier

3 2N2222
1 LM386 — available from Radio Shack stores
1 10-Ohm, 1/8-Watt resistor
1 150-Ohm, 1/8-Watt resistor
1 270-Ohm, 1/8-Watt resistor
1 2.7k-Ohm, 1/8-Watt resistor
2 5.6k-Ohm, 1/8-Watt resistors
1 10k-Ohm, 1/8-Watt resistor
1 12k-Ohm, 1/8-Watt resistor
1 22k-Ohm, 1/8-Watt resistor
1 47k-Ohm, 1/8-Watt resistor
1 51k-Ohm, 1/8-Watt resistor
1 10-megohm, 1/8-Watt resistor
1 100k variable resistor (trimpot)
2 0.039-uF ceramic disc capacitors
1 1-uF electrolytic capacitor, 15 WV dc
1 4.7-uF electrolytic capacitor, 15 WV dc
2 10-uF electrolytic capacitors, 15 WV dc
2 22-uF electrolytic capacitors, 15 WV dc
1 100-uF electrolytic capacitor, 15 WV dc
1 8-Ohm, 0.5-Watt PM speaker, 3-inch diameter

Receiver Mixer

1 GE-FET-2
1 100-Ohm, 1/8-Watt resistor
1 560-Ohm, 1/8-Watt resistor
1 100k-Ohm, 1/8-Watt resistor
2 56-pF silver mica capacitors
1 0.001-uF ceramic disc capacitor
1 0.01-uF ceramic disc capacitor
1 2–15-pF air variable capacitor (T-6-5)

Receiver Rf Preamplifier

1 GE-FET-1
1 100-Ohm, 1/8-Watt resistor
1 220-Ohm, 1/8-Watt resistor
1 10-pF silver mica capacitor
2 2–15-pF air variable capacitors

Receiver I-f Amplifier

1 2N2222
1 100-Ohm, 1/8-Watt resistor
1 560-Ohm, 1/8-Watt resistor
1 4.7k-Ohm, 1/8-Watt resistor
1 56-pF silver mica capacitor
3 0.1-uF ceramic disc capacitors

Miscellaneous Parts

BNC antenna connector, DPDT switch for T/R, 6" × 5" × 4" aluminum box, miniature microphone jack, and hi-Z microphone.

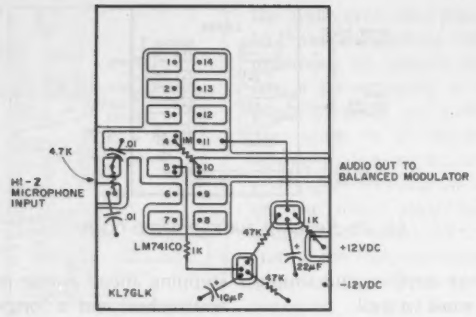

Fig. 27. Receiver audio amplifier board.

a stage, the audio preamplifier. The LM386 will provide enough audio gain to drive a pair of headphones for tuning up the receiver. The preamp can be added later. In fact, if headphones alone are adequate, the preamp can be skipped altogether. With a direct-conversion receiver it is important to have as much gain as possible into the audio section. If the preamp is omitted, place a 10-uF capacitor across pins 1 and 8 to increase the voltage gain from 40 to about 200.

Mixer

The receiver mixer is practically identical to the transmitter. Fortunately it is much simpler to adjust. L15 is identical to L12 and it is dipped for 5 MHz. C_P is peaked for 50 MHz. With 55 MHz on the source, a six-meter signal should now be evidenced as an audio signal. Go back and touch up L12 for the best response with the product detector.

Rf Amplifier

This rf amplifier is a compromise. I traded high gain for stability. When designing this transceiver, one of the things I kept in mind was a design that others could easily build. It is true that higher-gain preamps can be built, but they may require individualized attention to get them stabilized and working properly. This grounded-gate design still offers considerable gain but is rock stable. It will tune up cleanly right from the start. Another can be used for more gain if you wish.

Initially set C_A and C_B to 50 MHz with a grid-dip meter. Apply a six-meter signal, fine adjust the capacitors, and repeak the coils of the mixer and product detector for the best response.

The Basic Receiver

These four stages, the rf preamp, mixer, product detector, and audio amplifier, are essentially the receiver. There was a band opening the evening I completed these stages and I spent several hours just listening to the activity through a set of headphones. There isn't enough audio with this configuration to drive a speaker, so I added an i-f amplifier and an audio preamp.

I-f Amplifier

A single 2N2222 (Fig. 13) increases the audio output some. It also isolates the mixer from the product detector. Originally, I was going to use it to drive a ceramic filter since I feared the selectivity of such a simple receiver couldn't be much. But the more I listened the more I realized just how sharp this little product detector was. I could tune five separate QSOs between 50.110 and 50.120. Sure, they splattered on each other, but when the product detector was locked onto a desired signal, the voice came through sharp and clear. If you want more selectivity, a crystal filter can be added, but believe me, this is a good receiver without one.

Audio Preamp

The i-f stage hasn't enough gain to use a speaker with the LM386 audio amplifier. Direct-conversion receivers require large amounts of audio amplification, thus, they are prone to microphonics. This one is no exception. Be sure to firmly solder everything down on the receiver. The circuits will produce a characteristic ring whenever they are tapped if not securely attached. Fortunately, with the small components used, microphonics should not be a problem.

This preamp (Fig. 15) exhibits a very high gain; I would estimate it to range somewhere around 100 dB. It can drive the daylights out of an LM386 (and your eardrums as well if you use headphones). We now have plenty of gain for room-size-speaker operation, although the three-inch PM speaker I've used doesn't do it credit.

Loose Ends

By now you probably realize that a product detector is not tolerant of a noisy power supply. Voltage regulators that appear quiet for other uses set up a howl when used with this direct-conversion receiver and its high-gain audio stages. Filtering the incoming power lead, the power-line filter in Fig. 16 cures the problem.

Now add some sort of a T/R switch (a DPDT will do) to switch for both the rf and 12-volt functions. You are ready to go on the air.

Where to next? If you have gotten this far you've learned plenty about sideband, mixers, product detectors, and VHF in general. 50 MHz is just the start—see you on the microwaves! ■

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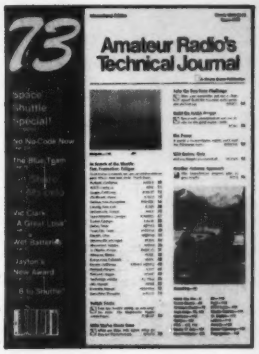

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SPECIAL EVENTS

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received by 73 Magazine by the first of the month, two months prior to the month in which the event takes place. Mail to Editorial Offices, 73 Magazine, Pine St., Peterborough NH 03458.

OAK PARK MI
JAN 5

The Oak Park ARC will present its annual Swap-'n'-Shop on Sunday, January 6, 1985, from 8:00 am to 3:00 pm, at Oak Park High School. Admission is $2.75 and tables will be available for $8.00. Features will include Novice exams—given at 11:00 am, refreshments, and free parking. Talk-in on 146.52. For more information, send an SASE to Oak Park ARC, c/o Jeff Smith N8FMQ, 459 Madison, Birmingham MI 48008.

SOUTH BEND IN
JAN 6

A hamfest swap and shop will be held on Sunday, January 6, 1985, at the Century Center, downtown on US 33 Oneway North between the St. Joseph Bank Building and the river, South Bend IN. Open tables are $1.00 per foot in a carpeted half-acre room. The Industrial History Museum is in the same building. Four-lane highways lead to the site from all directions. Talk-in on .52/.52, .99/.39, .93/.33, .78/.18, .69/.09, and 145.29. For more information, contact Wayne Werts K9IXU, 1889 Riverside Drive, South Bend IN 46616, or phone (219)-233-3507.

WEST ALLIS WI
JAN 12

The West Allis Radio Amateur Club will sponsor the "Original" Annual Midwinter Swapfest on Saturday, January 12, 1985, beginning at 8:00 am, at the Waukesha County Expo Center Forum (take I-94 to Co. F, south to FT, west to Expo). Admission is $2.00 in advance and $3.00 at the door. Four-foot tables are $3.00 in advance (December 31st deadline) and $4.00 at the door. Food will be available. For tickets, send an SASE to WARAC Swapfest, PO Box 1072, Milwaukee WI 53201.

TUSCALOOSA AL
JAN 12

A special-event station will be held on Saturday, January 12, 1985, commemorating the 63rd anniversary of the Tuscaloosa Jaycees. KE4TN will operate from 1300-2300 UTC on that date and will be offering an 8-1/2" × 11" certificate to all contacts. To receive the certificate, send your QSL card only (no SASE needed) to the Tuscaloosa Jaycees, PO Drawer L, Tuscaloosa AL 35404, or to KE4TN's *Callbook* address.

ISSAQUAH WA
JAN 13

The Issaquah ARC will sponsor the Rats Nest and Crooked Stick QSO Contest, an antenna experimenters' contest and QSO party, on January 13, 1985, from 1800Z to 2300Z. The frequencies will be CW—21.060 to 21.200 MHz, and SSB—21.350 to 21.450 MHz. A Rat Catcher's certificate will be available for anyone contacting three or more IARC members. Exchange your name, QTH, antenna type, IARC membership (Y or N), and send your log by February 1, 1985. For results or more information, send an SASE to IARC, c/o Steve Pack WB7VAS, 4609 158th Avenue SE, Bellevue WA 98006.

RICHMOND VA
JAN 13

The Richmond Amateur Telecommunications Society will sponsor the eighth annual Richmond Frostfest on Sunday, January 13, 1985, from 8:30 am to 3:30 pm, at the Virginia State Fairgrounds. General admission is $4.00. Flea-market spaces are $3.00 without a table and $7.00 with an 8-foot table. Booths with side curtains and backdrops are available to dealers and exhibitors and the building will be open Saturday afternoon for setup (there will be armed security at all times). The entire show will be indoors with no outside tailgating. The deadline for booths is December 30, 1984, and for the flea market January 10, 1985. For more information, write Richmond Frostfest, PO Box 1070, Richmond VA 23208, or call Bill Scruggs N4DDM at (804)-272-8206.

SOUTHFIELD MI
JAN 20

The Southfield High School Amateur Radio Club will sponsor its 20th annual Swap and Shop on January 20, 1985, from 8:00 am to 3:00 pm, at Southfield High School, 24675 Lahser, Southfield MI. Admission is $2.50. Two 8-foot reserved tables are $20.00 and each addtional reserved table is $10.00 (paid in advance). Tables will be available at the door. Doors will open at 6:00 am for exhibitors. There will be plenty of parking and food. All profits go toward electronics scholarships and to support the activities of the Southfield High School Amateur Radio Club. For more information, advance tickets, and/or reservations, write Mr. Robert Younker, Southfield High School, 24675 Lahser, Southfield MI 48034. Indicate with your reservation whether you will need wall space and/or electrical outlets. All table reservations will be confirmed.

SAFFORD AZ
JAN 26

The Eastern Arizona Amateur Radio Society will hold amateur-radio license examinations on Saturday, January 26, 1985, from 9:00 am to 3:00 pm, at the National Guard Armory, 4001 1st Avenue, Safford AZ. Prior to the registration deadline of January 21st, send a completed 610 form, a copy of any license, and $4.00 (registration fee) to EAARS, PO Box 402, Thatcher AZ 85552. For more information, call Richard N7DZH at (602)-428-6560 between 7:00 am and 3:30 pm.

YONKERS NY
JAN 27

The Yonkers Amateur Radio Club will sponsor the Yonkers Electronics Auction on Sunday, January 27, 1985, from 9:00 am to 3:00 pm, at Lemko Hall, 556 Yonkers Avenue, Yonkers NY. Admission for buyers and sellers is $3.00 each; children under 8 will be admitted free. New and used equipment will be auctioned and can be inspected from 9:00 am to 10:00 am. There will be plenty of seats and parking and the auction will start at 10:00 am sharp. Unlimited free coffee will be available all day. The club will charge a 10% commission on the first $100 and 5% on the remainder on successful sales only. Talk-in on 146.265T/146.865R, 440.150T/445.150R, and .52 direct. For more information, write YARC, 53 Hayward Street, Yonkers NY 10704, or phone (914)-969-1053.

HOUGHTON MI
JAN 29-FEB 5

The Michigan Technological University Amateur Radio Club and the Copper Country Radio Amateur Association announces a radio celebration of our winter carnival festivities in the northernmost part of Michigan's Upper Peninsula. A certificate will be issued to all amateurs who make one contact with any participating ham in Copper Country between 0000 UTC January 29, 1985, and 0000 UTC February 5, 1985. Frequencies are 3.630, 7.090, and 14.095 RTTY; 3.705, 7.085, 7.125, 14.085, 21.085, and 28.185 CW; 3.930, 7.285, 14.305, 21.385, and 28.500 phone. (On CW, listen for CQ WC.) Send your QSL and $1.00 to cover postage and handling to Howard Junkin N8FHF, 106 W. South Avenue, Houghton MI 49931.

MANSFIELD OH
FEB 10

The 24th annual Mansfield Midwinter Hamfest/Auction will be held on Sunday, February 10, 1985, beginning at 8:00 am, at the Richland County Fairgrounds, Mansfield OH. Tickets are $3.00 in advance and $4.00 at the door. Tables are $5.00 in advance and $8.00 at the door. Half tables are available. There will be an auction and flea market in large, modern, heated buildings. An ARRL/VEC license exam will be held at the Mansfield Campus of the Ohio State University/North Central Technical College (less than two miles from the hamfest) at 1:00 pm on the day of the hamfest. To take the exam, send an SASE, a 610 form, and a check for $4.00 payable to ARRL/VEC to Lloyd Nelson N8BAZ, 630 Oak Street, Lot 82, Mansfield OH 44907. Talk-in on 146.34/.94. For additional information or advance tickets or tables, send an SASE to Dean Wrasse KB8MG, 1094 Beal Road, Mansfield OH 44905, or phone (419)-589-2415.

MARLBORO MA
FEB 17

The Algonquin ARC will hold its annual electronics flea market on February 17, 1985, at Marlboro Junior High School Cafeteria. Doors will open for sellers' setups at 8:30 am and to the public at 10:00 am. General admission is $1.00; sellers' tables are $7.50 in advance (before February 9th) and $10.00 at the door. Food will be available. Talk-in on .01/.61 and .52. For table reservations or more information, write to AARC, PO Box 258, Marlboro MA 01752.

150TH ANNIVERSARY
SPECIAL EVENT
VICTORIA, AUSTRALIA

A special commemorative callsign, VI3WI, part of the 150th anniversary celebration of the European settlement in Victoria, will be on the DX bands until at least April 30, 1985. VI3WI will be activated on a roster basis by selected members of the Wireless Institute of Australia and its affiliated clubs. All DX bands and all modes will be used and a commemorative QSL is available, either direct or via the VK3 QSL Bureau. A special award certificate is also available for radio contact with Victoria between November, 1984, and April 30, 1985. Contact (SWLs log) one station in VK3 during the award period to qualify. A QSL card for the qualifying contact, endorsed with a congratulatory message on Victoria's 150th anniversary, plus $2.00 or equivalent, should be sent to Victoria 150 Award, Wireless Institute of Australia, 412 Brunswick Street, Fitzroy 3065, Victoria, Australia.

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REVIEW

REGENCY HX1000

Regency Electronics, Inc., has finally made available their long-awaited model HX1000, a hand-held automatic keyboard-programmable 30-channel, six-band monitor receiver. Rather than racing other manufacturers to be "first on the market," Regency has taken their time and produced a quality portable FM scanning receiver which surpasses any I've seen.

Physical Description

The Regency HX1000 is a double-conversion superheterodyne scanner designed to receive narrowband-FM communications in the amateur, public-safety, and land-mobile bands at 30–50, 144–174, and 440–512 MHz. Its microprocessor-controlled circuitry permits keyboard entry of frequencies into 30 channels to be scanned, either individually or in any combination.

At first glance, even a seasoned operator could be fooled into thinking the Regency is a portable transceiver. The radio is housed in a case closely resembling a handie-talkie in virtually every aspect. Measuring 2-3/4" × 7-3/4" × 1-9/10" and weighing approximately 1¼ pounds, the HX1000 has the feel of a conventional hand-held transceiver.

All frequency entries and status information are visible on the liquid-crystal display (LCD) on the center of the front panel.

Immediately below the LCD is the 16-key keyboard used to program and control the scanner. Along the bottom of the keyboard are slide switches for priority scanning and the night-display lamp.

Atop the scanner are found on-off/volume and squelch controls, a BNC connector, and a miniature jack with an attached dust cover.

A jack for an external nicad wall charger is on the bottom of the unit, as are contacts for a drop-in charger, available from Regency as an accessory.

The Regency HX1000 hand-held scanner.

In a departure from the Regency "made-in-America" tradition, the HX1000 is manufactured in Japan. However, this in no way detracts from Regency's reputation for quality.

The scanner comes handsomely packaged and is complete with such accessories as a nicad battery pack and connector cable, a plug-in wall charger, earphones, and a rubber helical antenna.

Operation

Operation is simple and easily learned. Upon removal from the shipping package, the user need only install the rubber helical antenna on the BNC connector and the battery pack in the compartment on the rear, and you're ready to begin programming.

Frequency programming into the 30 channels is accomplished in the manual mode by first keying in the frequency in megahertz, pressing Enter, and then keying in the channel number to which the frequency is to be entered (e.g., 01, 07, 24, etc.). The frequency is now entered into the selected channel unless the Error display appears, indicating that the intended frequency is outside the vco-lock range.

Once 30 frequencies (or any lesser number, according to the user's needs) have been entered, they will remain in the scanner's memory until reprogrammed or until the battery is disconnected. In order to automatically sample the channels entered, the Scan key is pressed. Whenever activity is located, the scanner will stop on that channel and monitor until the transmission ceases, then resume scanning.

In addition to functioning as a scanning receiver, the HX1000 can also search any selected frequency range within a band for active frequencies. Searching is keyboard-programmable using the Search Prog key to open the memory, and the Lower and Upper keys to enter the desired search limits, which are preserved in memory until changed. Search limits are retained when the unit is turned off. Searching is initiated with the Search Scan key and proceeds to check for activity on all frequencies between the lower and upper limits.

Searching is completed at a rate of approximately 17 seconds per megahertz on VHF and eight seconds per megahertz on UHF. When activity is located, the unit either remains on the frequency for four seconds (in the Search-Delay mode), or remains stopped indefinitely pending a keyboard command to proceed (in the Search-Hold mode). Frequencies located while searching may, if desired, be stored directly in one of the unit's 30 channels.

In the event that an extremely strong signal causes the search to stop on a frequency immediately before or after the actual carrier frequency, one-step frequency increment keys are provided to move the searching upward or downward one step at a time. With the squelch fully open, these keys may be used to manually step up or down from a frequency during searching, and will step continuously at a slow rate while depressed.

On the VHF bands, frequencies are programmable in increments of 5 kHz, and in increments of 12.5 kHz on UHF, with corresponding search steps.

As a battery-conservation feature, the LCD clock has a switch, located inside the battery compartment, which can either be set to furnish power to the clock at all times, or only when the scanner is turned on. In the latter position the clock must be reprogrammed each time the scanner is turned on in order to maintain correct time.

Each time a key is pressed, a beep is heard, verifying the entry. This beep is audible only through the earphones when this accessory is used. It cannot be silenced.

Priority scanning of channel one is controlled by a front-mounted slide switch. The scanner samples the frequency in channel one once every two seconds and switches to it if activity is noted. When scanning a number of channels or listening to a lengthy transmission, this feature can be quite handy to keep tabs on a local repeater or emergency frequency. This feature functions in the manual mode as well.

Selectable scan-delay is available, covering all channels. This delay keeps the scanning action stopped for two seconds on the channel after transmissions cease.

The LCD is multi-functional, displaying not only the frequency in megahertz but also the channel number, and indicates whether priority is engaged and if scan-delay and channel lockout are present. Also, it shows "Batt" when recharging of the nicad pack is necessary, and also serves as the clock display.

To facilitate night viewing there is a display back light, incorporating a battery-conservation feature which discontinues power to the lamp if it is left on for more than 20 seconds. This light is more than just a novelty; it not only illuminates the display at night, but also provides sufficient light to operate the keyboard.

A leather carrying case is supplied which has an opening to access the wall-charger jack and a transparent plastic covering over the keyboard. This permits keyboard operation with the case on while protecting keys from dust and moisture. A sturdy metal belt clip is also included and may be used with or without the leather carrying case. The clip is installed with two Phillips-head screws onto the back of the scanner, and it is necessary to remove these screws each time you want to remove or replace the carrying case (the screws go through the leather case and into the back of the scanner). This can create a problem when it's necessary to reset the microprocessor, as you have to remove the belt clip to remove the carrying case to access the battery compartment and switch.

Upon inspection of the circuitry, one finds that the compact complexity of the HX1000 is made possible by stacking the PC boards atop one another. The rf package is on the board immediately visible when the back cover is removed. Concealed behind this are the programming-logic and synthesizer boards, connected to the keyboard and the rf board via jumper wires.

Examining the boards, I noted that all are connected with brass spacers to the die-cast aluminum chassis. This makes the boards somewhat more vulnerable to damage due to physical shock to the outer case and, combined with the glass of the LCD, underlines the importance of using care in handling.

User Comments

Upon examining the HX1000 and comparing it to other synthesized hand-held, base, and mobile scanning receivers, I find that it excels in both the quality of the scanner's construction, sensitivity, and clarity of audio. All operational characteristics either meet or exceed those listed in the owner's manual, and the keyboard configuration and programming sequence are easy to learn and remember.

In searching across the bands, remarkably few birdie frequencies were encountered—an unusual observation with a newly-introduced scanner.

The LCD readout is highly visible under various lighting conditions when viewed straight on and provides enough information to the user without adding any unnecessary and confusing graphics.

According to specs published in the owner's manual and sales advertisements, the HX1000 covers ranges of 30–50, 144–174, and 440–512 MHz (subdivided by Regency into six bands). The manual states that should you attempt to enter an out-of-band frequency, "Error" will be displayed. However, this display is apparently triggered only when the vco fails to lock, and not upon recognition of an illegal keyboard entry. Thus, it is possible to enter frequencies far outside the listed ranges. My unit was able to be programmed to search and scan from 25–60, 116–190, and 305–530 MHz! While different radios will be able to cover slightly different frequency extremes due to manufacturing tolerances, it is a safe assumption that most units should be able to cover at least 5 MHz above and below the published band limits.

Note that the radio was designed to operate at maximum sensitivity only within the standard bands, and when venturing farther from the regular band limits a corresponding decrease in sensitivity will be noted. Even so, signals on 10- and 6-meter FM and in the 410–420-MHz range were as readable as regular channels on VHF-low and UHF, respectively.

This coverage of frequency ranges outside the regular bands including 6 and 10 meters, added to the regular 2-meter and 440–450-MHz coverage, makes the HX1000 a super low-cost synthesized receiver for amateur VHF/UHF FM communications. With 30 channels at your fingertips, there is more than ample memory capacity to store your favorite repeater or simplex frequencies.

The nicad wall charger supplies the scanner's appetite for 200 mA of charging current (this is the value marked on the charger, and differs from the value of 100 mA specified in the owner's manual). However, the powerful battery doesn't have to spend much time in the charger before it's ready to go.

The scanner exhibits excellent sensitivity, clearly pulling in Ohio stations at the author's home near Pittsburgh PA, while both nearby base and mobile "brand name" scanners on the same frequency showed no evidence of a received signal with squelch fully open! Further, there was no evidence of intermodulation interference under most conditions (certainly superior to several other synthesized units I've tried). Selectivity was also excellent. Sensitivity is rated at 0.5 uV on VHF and 0.7 uV on UHF, both as measured at tune-up, 12 dB Sinad. Selectivity is down 6 dB at ±7.5 kHz and down 50 dB at ±18 kHz.

The rubber helical antenna supplied with the scanner provides very good reception compared to other portable scanner antennas. Nevertheless, one is tempted to attach an external antenna to the top-mounted BNC connector in an effort to further improve reception (particularly if using the HX1000 as a mobile scanner). Regency cautions against this, however, stating that other antennas may cause improper impedance matching and may cause "reduction in effective receiving range, increase of spurious radiation, and excessive battery drain." No antenna impedance rating is listed in the specs. Still, one is tempted to experiment.

To facilitate easy operation of the HX1000, the owner's manual is well written and contains complete and concise operating instructions.

Regency's suggested list price for the HX1000 is $329.95, but various mail-order firms specializing in scanners have been selling the unit for between $206 and $250 plus shipping.

Conclusion

The Regency HX1000 is a superior receiver which makes a handy addition to any shack. Its portability and performance make it a truly useful receiver for emergency operations and for monitoring VHF/UHF amateur and public-safety systems, exceeding the capabilities of many contemporary base and mobile scanners. Of all the scanners I have owned, the HX1000 is among the best in price, performance, and versatility.

For additional information, contact *Regency Electronics, Inc., 7707 Records St., Indianapolis IN 46226-9989; (317)-545-4281.* Reader Service number 485.

Louis Smith II N3BAH
Latrobe PA

MINI JINI AND THE ORGANIZED HAMSHACK

Pity your poor reviewer! I'm absolutely buried under new software packages for use with home computers in the ham shack. I know, it's not a pretty sight.

I doubt that I'll get much sympathy for my situation. After all, it is fun getting to try out new products. Sometimes, though, it becomes tiresome, seeing the tenth software package to do the same thing. It's particularly trying when the instuctions are unclear, the program is poorly written, and the results just don't seem worth it.

That's the way this particular Sunday afternoon was going until Mini Jini rose to the top of the stack!

First of all, I didn't even have to load the program. It comes on a plug-in cartridge for the VIC-20 and C-64 computers. Then, I didn't even have to tell it to run. When I turned on my machine, like magic the credit page and then a menu appeared.

Weary from trying to decipher instruction manuals that didn't tell me what I needed to know, I approached Mini Jini expecting more of the same. Jini Micro Systems advertises this package as being written in plain, simple English. That advertising claim turned out to be absolutely on the mark!

A forty-page instruction manual comes with Mini Jini, but it doesn't really take very long to read the simple instructions and go through the examples provided. I also found the instructions well indexed, a definite plus for any instruction book.

What is Mini Jini? In two words, it is a record keeper. What? No fancy terms like data base or electronic spreadsheet? Not for Mini Jini. Remember, it's written in English!

In computer terms, Mini Jini is a data base and offers the features you would expect to find in such a program. It will let you keep a top-notch logbook, track your QSL cards, record progress towards awards, or serve as a foreign phrase book. If you must have a non-ham reason for buying it, you can generate financial statements, keep an inventory of your household goods, or track junior's academic progress... all with the same program!

The main menu for Mini Jini lets you create, look through, order (alphabetize), search, or fix a file. You can print the information to the screen or a printer. Additionally, you can save and load files you create to disk or tape.

If that's not enough, a feature called math pack allows you to do calculations on the different entries in your number files.

Mini Jini makes efficient use of memory space. The Commodore 64 version has a capacity of 500 45-character records with four fields or less. A fully expanded VIC-20 allows a similar number of records.

There are many logbook programs on the market. Some of them are quite good. Almost all of them are considerably less expensive than Mini Jini. So why buy this program?

In most cases, logbook programs are exactly that and can't do anything else. In their favor, many of them provide beam headings, DX prefixes, zones, and other information that Mini Jini does not. If you are inclined to create them, Mini Jini can handle all of these functions and a lot more. With the dedicated systems, you are stuck with the limitations of the program.

Creating files on Mini Jini is just as easy as falling off a log. If you are really lazy, the Organized Hamshack series of overlays is available for $12.00 (disk) and $9.00 (cassette) to complement Mini Jini in the ham shack. The overlays (another one of those new-fangled computer words) provide 13 different file types for you to use, including a logbook (one in English and one in Spanish!), a DXCC log, a ham station inventory, and a mailing list.

One of the more unique files included is a "Ham DXtionary," so you can cross-reference frequently used foreign phrases.

The overlays, particularly ones like the DXtionary, would be much more impressive if they actually included a good number of useful entries. Only the format is provided, however, with one or two examples. Understand that for the price, I don't consider this a shortcoming, only a suggestion for a possible addition to the product line!

Mini Jini, at $49.95, is a full-featured record keeper. It will take care of the club mailing list for you, organize your emergency call-out lists, allow you to have virtually "instant memory" while on the air, and help you figure your taxes at the end of the year. Incidentally, the files created by Mini Jini are compatible with several word-processing packages such as Wordpro and Papermate.

Mini Jini is available through *Fox Tango Corporation, Box 15944, West Palm Beach FL 33406; (305)-683-9587.* Reader Service number 481.

Jim Grubbs K9EI
Springfield IL

AEA's TI-1 tuning indicator.

AEA'S TI-1

Here's a new station accessory that you ought to know about, especially if you're a RTTY enthusiast and don't happen to have a scope to tune in those narrow-, medium-, and wide-shift signals. The TI-1 is a tuning indicator (bet you guessed that already) that can help easily and quickly tune your receiver to the exact frequency for decoding RTTY/AMTOR and ASCII.

You will need a source of 12 volts dc at just a few mils to power it, and you'll need a patch cord and a couple of 3.5-mm plugs to connect the TI-1 to your interface (or your receiver, depending upon the particular hookup you have). That's all there is to it. In my own case, I hooked the audio from the receiver through the TI-1 and into the AEA MicroAmtor interface... simple in/out.

There is a switch on top that allows you to select 170-Hz, 425-Hz, and 850-Hz shifts, and there is an internal speaker if you want or need it (the speaker can be switched on and off).

The tuning operation is simplicity itself. On the top of the box is an LED strip in which the LEDs occupy a "window" about 2 inches wide and 1/2 inch high. When the TI-1 is turned on, you don't see much of a display until you tune across a signal, and then it's really impressive. The mark and space tones light up the LED—and you can actually see the separation. Very bright at the mark and space locations, shading off to a duller red in between. To properly tune the signal, line up the bright mark and space tones with the respective "pips" on the box just underneath the window. Believe it or not, they exactly fit, and when the mark LED is brightest and lined up exactly on the mark pip, you have exact frequency tuning.

Just for fun, I tried some different widths and switched the filters in and out so that I could watch the signals spread and narrow, depending on which tone pair I was tuned to.

Just in case you can't remember which frequency is which, just look at the box—it's all there in white numbers on black crackle: 2125 at the low end; 2295, 2550, and 2975 at the high end. In between, you see the shift widths, just so you can't forget: 170, 425, and 850 cycles.

My impression of all this was that this is a really neat, useful, and simple device that can make RTTY tuning a snap for anyone. I wouldn't hesitate to recommend it, and it doesn't seem possible that even a scope and the crossed lines could more accurately or easily tune in the RTTY frequency shifts.

For more information, contact *Advanced Electronic Applications, Inc., PO Box C-2160, Lynnwood WA 98036; (206)-775-7373.*

Jim Gray W1XU
73 Staff

DX

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DXING ON THE LOW BANDS

The Federal Communications Commission (FCC) finally dropped the other shoe in its proposed expansion of the phone subbands. This process began in 1982 when the FCC suggested increasing the phone frequencies on 20 meters. When they did grant additional phone spectrum, the FCC mentioned they were looking at expanding the other high-frequency phone subbands as well. So, on September 1, 1984, General and higher-class licensees gained new phone frequencies.

In case you have been living in a cave the past few months and haven't heard about the changes, here are the new frequencies:

Extra-class operators gain 3750-3775 and 21,200-21,250. Advanced-class ops can now use phone on the new subbands of 3775-3800 and 21,225-21,270. Generals gain access to 3850-3890 and 21,300-21,350. All three classes get new phone frequencies on 10 meters: 28,300-28,500. Of course, all these changes are in *addition* to the previously existing phone subbands.

With the declining sunspots, the effect of the increased phone frequencies on the 10- and 15-meter bands won't be very obvious for a few years. 10 meters has always enjoyed ample phone spectrum, even at the peak of the sunspot cycle. Also, most rigs have the frequencies below 28,500 on a separate band from the commonly used region between 28,500 and 28,700. I would suspect that the new phone subband on 10 won't have much effect on DXers. Perhaps some of the localized communications and nets will leave the more heavily used frequencies for this new subband. We'll have to wait and see.

The expansion of the 15-meter phone band will have some immediate effect on DXers and DXing, an effect which will grow in importance as the sunspots again make 15 a worldwide band. The extra 50 kHz which the Extras gained is prime DX-ing country. Much of the worldwide phone

DX activity takes place between 21,200 and 21,300 on 15 meters, and now US Extras have twice as much subband in which to stalk the elusive DX operator. The 45 kHz the Advanced-class DXer gained is again very prime DX territory.

Of all the increases in the subbands, however, the most important is the new 25-kHz segment on 75 meters which the Advanced operators now enjoy. The Extras gained the same amount of subband, and the Generals were rewarded with 50 kHz also, but the new frequencies will have the most impact on Advanced DXers.

The reason the Advanced DXer is the real winner in this phone subband expansion is the "DX Window" on 75 meters: 3775–3800. As any phone operator who has listened to 75 meters can tell you, 90% of all the phone DX on 75 meters is within this window or just below it. Seldom does one hear much DX above 3800. As a result, phone DXers with Advanced licenses had been just about frozen out of 75 meters—until now.

The primary reason DX stations congregate in the 3775–3800 window is international amateur frequency allocations. Only in International Telecommunications Union (ITU) Region 2 (North and South America) are amateurs allowed to operate up to 4000 kHz on 75 meters. Region 1 amateurs (Europe and Africa) cannot use 75 above 3800. In fact, the interference levels above 3800 are so bad in many places in Region 1 that even *listening* for amateur stations above that frequency is a waste of time. So DXers have a very limited overlap of phone frequencies on 75 meters.

So Advanced-class phone DXers have won a real plum: access to the best 25 kHz in the entire 75-meter phone subband! This, coupled with the declining higher-frequency propagation which pushes DXers off 15 and 20 meters, means much more activity in low-band DXing. Let's look at some of the thrills and frustrations involved in DXing on the lower frequencies, and some of the ways around them.

Many hams associate DX with 20 meters, and then 10 and 15. Relatively few amateurs think seriously about DXing on 40 and 80 (much less 160 meters!). Why is this? Three main factors keep the majority of DXers off 40 and 80 meters: too much noise, weak signals, and the need to work split (on phone). We'll see how you can handle each of the stumbling blocks, without investing in a three-element, rotatable 80-meter yagi.

Combating Noise

The only time 75 meters is quiet is when it's not open. Newcomers to the band are quickly disheartened by the unbelievably high QRN levels, especially in the summer. How can anyone hear DX signals between 40-over-9 static crashes? Even in the dead of winter, the interference level can be murder. And built-in noise blankers seem to provide little relief.

The solution to the problem of noise is simple: you need a poor antenna. That's right, a lousy, high-loss antenna. The worse your antenna, the less noise you receive. With a good dummy load (which makes a pretty bad antenna), you won't hear any noise at all. Of course, you won't hear any DX either. What you need is an antenna which only receives DX, and not the noise.

Since nobody has seen fit to invent one yet, we have to settle for an antenna which only receives in one or two directions. Here comes that 3-element beam, you say. But you don't need the beam. Remember, we were looking for a poor antenna, not a good one. Lousy, directional antennas for 80 meters include Beverage antennas and loops.

The Beverage antenna is simply a very long wire stretched a few feet off the ground, aimed in the direction you want to hear. The longer the wire, the more directional the antenna. At least a few hundred feet helps on 80, and a quarter-mile is great! The Beverage doesn't have to be anything fancy. A roll of transformer wire hanging from bushes and tree limbs works fine. Take care to keep the wire above head level in high-traffic areas. You can run the wire along wooden fences—it doesn't have to be exactly straight to be effective. Since the antenna is only used for *receiving* (see below), there is no need for any insulators.

An alternative to the Beverage for the DXer who simply can't stretch out a quarter-mile of wire is the loop antenna. Check the various handbooks and antenna books for details.

Both the loop and the (unterminated) Beverage are bi-directional antennas: They receive relatively well in two opposite directions and very poorly in others. The loop works best broadside to the loop, while the Beverage works best along the axis of the antenna. Since the noise on the lower bands comes from all different directions, these antennas greatly reduce the level of received noise. They only hear noise in the same direction as the signal, which is only a fraction of the total.

Two precautions with either antenna: They are receiving antennas *only*, and neither antenna will provide much in the way of received signal strength from the DX station. Since these antennas can only be used for receiving, you must find some way to prevent accidental transmissions into the antenna. Some full-feature transceivers have an external receive-only antenna jack somewhere. Check the transverter jack for such a connection if there is no obvious jack. If you try to rely on manually switching between a receiving and a transmitting antenna, you will "cook" your loop or Beverage while trying to work a rare one. Install either a simple relay circuit or an automatic switch if you can't work out an internal connection to the transceiver. Of course, owners of separate receivers and transmitters have no problem "smoking" their receive-only antenna.

The final difficulty with Beverage and loop antennas is the poor signal strength such lousy antennas provide to your receiver. You may well find you need a preamplifier in the line to boost the DX signal to a readable level. Again, make certain there is absolutely no way you can transmit into your preamp, or someday you will!

Dealing with the Weak Signals

The same preamp which compensates for the losses of the receiving antenna will help overcome the handicap of the poor signal strengths of the DX station. However, a preamp won't do *your* signal any good. Weak signals simply don't hack it on 80 meters, and transmitting amplifiers are definitely the norm. Even a good amplifier is not enough to be loud on 80—you also need an effective antenna to work DX.

The secret to an effective DX antenna on the lower frequencies is low-angle radiation. That is, radio signals traveling parallel to the ground and not straight up. Many amateurs use a relatively low dipole for 40 and 80 meters. While excellent for local, short-range communications, such a low dipole is one of the poorest choices for DX. A glance at almost any antenna book will show the cause: at low heights above the ground, dipoles radiate almost straight up. All of your signal goes straight up and straight down, and little goes off toward the faraway DX station. You need an antenna which concentrates more rf in the lower angles for better long-distance communications.

What kind of antenna does this, besides the three-element beam? A high dipole will work, as will a vertical over a good ground. By "high" I mean high in terms of wavelength: a minimum of one-half wave high. That's about 130' on 75 meters. That's high! Since most of us don't have two 130'-high supports in our backyard, we pass over dipoles for DX on the low bands.

Verticals *theoretically* radiate much of their rf at very low angles. However, those nice charts in the antenna books are based on a *perfectly conducting ground*, not those two radials you managed to sneak into your yard. The worse the ground, the less low-angle radiation escapes from your vertical. Again, a "good" ground is something completely out of the question for many amateurs. To get good low-angle radiation from a vertical requires 120 one-half-wavelength radials, a circle 260' in diameter with *3 miles* of wire!

Not many DXers have *that* much dedication to the hobby. Fortunately for the rest of us, any radials will help, and the more the merrier. Even doubling the number of radials from 2 to 4 will make a difference. As with the Beverage, the radials don't have to be exactly straight—just string them out wherever you can.

Some amateurs are more serious about their grounding system. 9L1CA covered his entire front lawn with criss-crossed wires before seeding. The lawn grew up over the wires and the system worked splendidly with a pair of 80-meter loaded verticals. And one southern-California 80-meter DXer still laments "the one that got away" when he had rolled up his chicken-wire grounding system to mow the lawn.

For DXers fortunate enough to have a tower for the high-frequency antennas, several antennas will provide better results than a simple inverted vee on the low bands. Many hams have had very good success with sloper antennas. These very simple antennas are single wires running from near the top of the tower (where the coax shield is grounded to the tower) out in the direction of the DX. Little tuning is required. In some cases this sloper will provide good low-angle radiation and good DXing. Switchable slopers in different directions can cover the world.

Another antenna for hams with a tower is a half-wavelength loop antenna, with the peak hung from near the top of the tower. You can stretch out the loop facing the direction you desire and feed it in one corner. The loop is more broadbanded than the sloper, but it requires more real estate. Both antennas are simple, easy to build and use, and well worth the effort for the low-band DXer.

When and Where

Okay, we've got a good receiving antenna up and running and our transmitting antenna has good low-angle radiation. Now how do we find DX on the low bands? The best time to find DX on 40 and 80 meters is when the maximum usable frequency (MUF) is just above those bands. When the MUF is very high, above 14 MHz, the low bands are washed out with absorption. Only at night do 40 and 80 provide good DX possibilities. In fact, one of the best times to look for DX is just before and during local sunrise. Sunset is the time to look for DX to the east. In the wee hours of the morning, local time, when few nearby stations are on the air, is another prime time for low-band DX. (I will talk more about sunrise, sunset and the grey line in a future column.)

As to *where* to look, you have to pay attention to international frequency allocations outside the United States. While you can work some "local" DX, such as the Caribbean, on frequencies above 3800, most long-haul 75-meter DX hovers around 3775–3800.

On 40 meters, the international allocations outside North and South America limit amateurs to frequencies below 7100. Thus, on phone you must listen in the 7050–7100 range for DX stations on phone. Those stations will announce "listening frequencies," such as, "listening on 7183."

You, of course, cannot transmit phone on 7060, or wherever the DX station is. Even if you could, he isn't listening on that frequency, so it would be a waste of time to call him there. (But that doesn't seem to stop people from trying, or others from griping about the practice.) You must transmit on 7183, or thereabouts, while listening at 7060. Sometimes the same situation applies on 75, where the DX station is well below the US phone subbands. Russians, for example, can often be found around 3642, a "hole" in the very heavy 80-meter interference in that part of the world.

Working Split

You need to be able to transmit on one frequency while listening to another. Most rigs let you do this over a limited frequency range. It's called RIT or clarifier, or some such name. But the frequency splits on 40- and 80-meter phone are far outside the range of your RIT.

You can try spinning the dial back and forth between the two frequencies, but the chances of this working are not good. More likely, you'll end up transmitting out of the stateside phone band, and have half the world yelling at you.

Far better is a second receiver, or extra vfo, or one of the fancy new rigs with all kinds of memories and programs to handle "working split." Ideally, you want to be able to listen to *both* the DX frequency and the one on which you are sending, so the second receiver is the best solution. It doesn't have to be anything fancy; almost any halfway decent amateur receiver will do, especially with a directional antenna and preamplifier.

If you use a memory switch or extra vfo to split your transmit frequency from your receive frequency, use the fixed frequency on the DX station and tune your transmitting frequency. The DX station is not going anywhere, as he isn't even listening to the frequency on which he is sending. (Actually, he relies on the stations he is working to tell him if his transmit frequency remains clear.) So lock the fixed frequency on the DX station and then tune your transmitting frequency in the range given by the DX station.

If he sends "listening 7183," you tune around 7183 and call him. Don't bother to send *his* call, just send yours. Listen down below 7100 for his reply. If you can, also listen to his listening frequency for the station the DX station last worked. If you can transmit on the same frequency as the last station worked, you stand an excellent chance of being next in the pileup. And the only way you can do this is if you can listen to your transmit frequency.

The proper procedure takes some finesse. The trick is to listen to *both* the DX station and your own transmitting frequency at the same time. While the DX station is listening for his report, you tune around the listening frequency for the sta-

tion giving the report, the station in contact with the DX station. You won't find him right away, and sometimes the DX station will tune away soon after the contact, but with practice and perseverance, you'll locate the other station. Zero-beat your rig on that frequency.

Then, when the DX station says, "QRZ," you jump in with your call. You know the DX station is listening on that frequency; he just finished a contact there. If your timing is good, bang!, another new one in the log!

A good example of how important this technique can be was seen in Ron Wright's DXpedition to the Kermadec Islands last March. On CW Ron *said* he was "listening up," as is common practice. Actually, Ron worked many stations *below* his transmitting frequency. The only way to know this is to listen to both Ron and the station he is working. Once you note that he is working stations *below* his transmitting frequency, you can zero-beat the last station worked and call Ron. Without the ability to listen to your own transmitting frequency, your chances of working Ron were significantly reduced.

With these hints in mind, you should be able to work your share of DX on the low bands during the winter. DXing on 40 and 80 meters is not for everyone. It is not an after-dinner activity. It means going to bed after dinner and getting up in the middle of the night to pick through static and interference, and probably hear nothing at all. On the other hand, some nights 75 meters provides some of the most exciting and satisfying hours of DX. Most of my fondest memories of DX are of late nights when "the band was open" on 75: working dozens of rare Russian republics as the sun rose over Asia, giving scores of "peanut whistles" their first DX on 75 in a late-night WAS net, working Europeans from the Galapagos, with YS9RVE as emcee, and many more episodes.

So give 40 and 80 a try. Next time we'll discuss some of the ways you can listen to both your own frequency and the DX station at the same time! Stay tuned.

LETTERS

SPECTRUM LOSS

In reading your September commentary on the Morse-code requirements, technology, and the future, a thought occurred to me. If many areas of the USA are not utilizing the spectrum above 450 MHz, and we are in fact risking the loss of that precious spectrum, why not make a communicator or an ASCII-only class of license for something like 1296 MHz? Seems to me that here would be a perfect location to try the idea out, and just how many present users would be put out? Just how many people are using 1296 or 10,000 MHz? What percentage of hams? Just maybe we would be aghast to find out how many hams have *ever* used 1296, much less a Gunn-diode transceiver.

As you know, modern 1.2-GHz equipment is now produced by at least one company (ICOM) that also produces an off-the-shelf repeater for 1.2 GHz. Computer clubs are rich and crazy enough to promote a great way to ship 1200-baud data without wires and without the monthly bill from the local phone company. Maybe this would be an angle to consider.

I'll bite on your comment. What does one have to do to petition this kind of an idea to the FCC, or would it be a waste of time because some self-styled organization would dropkick the idea out of the stadium as soon as they heard it?

John Lockwood
Orem UT

One merely writes one's proposal to the FCC, Washington DC 20554, preferably with innumerable (16) copies and the original notarized. And yes, the likelihood is that the organization you referred to will fight you tooth and nail.—Wayne.

NO VOICE

I am writing this note out of appreciation for your dedication to amateur radio. I have been instructing classes in my town for several years in both Novice- and General-class code and theory. Very few school-age children apply, and overall I have a very high dropout rate. No one else in town (we have 12 or 13 hams in a town of 6000) wants to teach a class, so if it gets done, I do it. Very few have dropped out because of the code. Only those who couldn't spell had trouble. Most left because the Novice license includes no voice privileges.

Traditionally, Novices had voice on 145–147 MHz. I believe that since the Novice ticket is a 10-year renewable license, some voice privileges should be included. Wouldn't it be swell if the FCC allowed 200 Watts PEP phone for Novices in the new 10-meter phone band at, say, 28.325 to 28.375 MHz? This would give incentive to aspiring Novices, create a new market for SSB equipment, and provide lots of use for converted CB sets. Since we'd like to attract the young computer set, perhaps we could also ask for Novice RTTY privileges using ASCII on 28.190 to 28.200 MHz. Then we could offer Novices with computer/modem experience a place to play.

What do you think, Wayne? I don't know how to go about petitioning the FCC. Can you help me? Are these good ideas? How about changing the CW test for amateurs to: Novice, 5 wpm; Technician, 10 wpm; General, 15 wpm; Advanced, 20 wpm; Extra, 25 wpm. Is this too hard on the amateur community? Then how about: Novice, 0 wpm; Technician, 5 wpm; General, 10 wpm; Advanced, 15 wpm; Extra, 20 wpm? There, we haven't hurt the Extras, the Advanced can cope with 15, the Generals get a break, Technicians get no change, and the Novices have to know code to operate anyway, so why test them? Just let them have at it.

Larry W. Garens KC5OQ
Brady TX

Fine, see my comments to Lockwood. —Wayne.

KEEP PUSHING

Keep up the good work! I enjoy your editorials immensely. It's very nice to read views which are both innovative and futuristic. Your dedication to amateur radio and the advancement of electronic technology is very evident and appreciated.

I have been teaching senior high school for sixteen years with varying success in inspiring students to study for their ham ticket. You hit the nail right on the head—kids today do suffer from the immediate gratification syndrome. The only goals they perceive as worthwhile are immediate. I have tried too many different approaches to detail, but I can't get past the immediate gratification problem. It's worse today than it was 10 years ago. At one time I had 14 licensed hams in school. Each year it has become fewer until now I have only one. I like your idea of trying a no-code license. I know 15 years ago I had a lot of trouble with the code, but I didn't suffer from immediate gratification syndrome and I made it.

It's too bad the league didn't pick up on no-code licensing before you started the push. It seems certain people can't stand the thought of Wayne Green being right again! Keep pushing, Wayne, for no-code licensing; you know you are right, I know you are right, and a lot of other people know you are right but won't admit it!

I have come to the conclusion that people who think like us are in the minority because technology has moved too fast for most to comprehend. A lot of hams, teachers, administrators, school boards, and parents are too naive to comprehend the type of education needed by their children to survive in our technological society of today. Someone once said that you never stop learning. What we have to do, Wayne, and others like us, is *never stop teaching!*

Phillip Wedige WB9PCI
Sun Prairie WI

HINT

I read with great interest "Perfboard and Soldertail?" in the July, 1984, edition of *73*, and also AF9Q's letter concerning additional techniques. One hint that I would like to share concerns the way AF9Q (and probably many others) cuts out the copy of the board layout. I have used a slightly different method for quite some time and have turned out some very nice boards.

After obtaining a good copy of the layout (thus preserving the original) and taping it to the board, I use a sharp, pointed tool such as an ice pick to carefully pierce through the paper and into the copper board. Not only does this system tell you exactly where to drill the hole, but the dent serves as a pilot hole for the bit. I know from experience what one slip of the drill can do to a board!

Robert Gooch, Jr. N3DRW
Baltimore MD

LISTEN

While I find your editorials interesting as well as informative, you have failed to put any effort into helping the new Novice. In your editorials you have harped on the subject of getting teens involved in amateur radio. That is all well and good, but any campaign to get teens involved will be

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of no avail if you or others in the amateur community fail to realize that there are at least two major problems facing the new Novice.

First, the Novice subband at 40 meters is not totally useable due to broadcast stations like the BBC using a great portion of this band. Have you approached the FCC about this? Has the ARRL done anything? If so, I haven't seen it.

Second, it seems as though the amateur community is not generally willing to make a QSO with a Novice due to his mistake-ridden, slow-fisted style. Is it any wonder why more people, including teens, are not willing to put forth any effort to become a part of the amateur fraternity?

Another large problem that teens face is money. Look at the ads in your magazine. The equipment is not cheap by any stretch of the imagination. How can anyone be expected to become interested in ham radio under these conditions?

Will we lose the 220-MHz band? Unless something is done to encourage our Novices things will get worse. Then the question of a no-code license crops up. The excuse that code is too hard to learn or to cope with is a feeble one. Just look at the pre-teens who are "coping" with it. If a pre-teen can do it, why can't a few adults?

I am very surprised to see that no one seems to care about *these* problems instead of the dead no-code issue. I agree that we as amateur-radio operators do need to be concerned about losing spectrum, but shouldn't we be *more* concerned about bringing teens into amateur radio, and making it attractive enough for them to stay? If you are not aware of the problem of broadcast stations on the 40-meter Novice band, listen! If you are not aware of the lack of consideration given our Novices, listen!

Can you not see what is happening? Take a good look at our Novice subbands. Then write your editorial so that our Novices know that you, the FCC, and the ARRL care.

Bill Dethlefsen KA9RAP
Chicago IL

RTTY LOOP

Marc I. Leavey, M.D. WA3AJR
6 Jenny Lane
Pikesville MD 21208

Well, I see by the old calendar on the wall that the Orwellian year, 1984, has passed us by, and Happy New Year to you all!

Gotta start out this month with a quick look back. In November, 1984, I detailed a scheme thought up by Jim Conner W3HCE for interfacing a Heathkit® HD-3030 RTTY terminal unit to the station. Well, Jim passes along that there are two errors in the main schematic, shown in Fig. 1 of the column: 1) pin 4 of S1C should go to pin 1 of the VHF transmitter plug—*not* to pin 2 of the VHF transmitter plug, and 2) pin 4 of S1G should go to pin 3 of S1E—*not* to pins 3 and 4 of S1D. Otherwise, according to Jim, all is correct as published. I will be interested to hear from those of you who put this interesting interface to use.

Continuing in the New Year/new broom department, back in September, 1984, I mentioned that Tom Zeltwanger KG3V has a RTTY program available, but I stated that it was for the wrong computer! Sorry about that, Tom. To set the record straight, Tom's program is for the Commodore 64, only. I am sure he would like to hear from you, at PO Box 62, State College PA 16804, if you are interested.

A question relating to a really old column has been received from Dayton Johnson W8ZI. Dayton was looking at the listing of Murray versus AMTOR codes published in November, 1983, and questions whether the Murray is not inverted. Well, Dayton, it all depends on how you look at it. For example, in my list I stated that the code for the letter A is 11000. With 1 representing mark and 0 representing space, this is the way the character is usually presented. Similarly, the ASCII letter A is 01000001. However, and this is the root of the confusion, the ASCII code is sent from the least significant bit to the most significant bit, that is, from right to left. The Murray, on the other hand, is sent from left to right, most significant to least significant.

The practical application of this is that the parity bit, if used, appears as the most significant bit, which is the last one sent. So, if you do not use a parity bit on ASCII, the stop bit or bits take its place. There is no parity bit in Murray, and the way the bits are presented goes way back to the days of punched tape. In that medium, the leading 1 of the Murray A would be at the upper edge of the tape, so, reading top down, 11000 would be the logical reading. Of course, ASCII punched tape looks the same way, but the characters are transmitted in the reverse order. Hope that clears things up.

Another little mistake, let's call it a typo. Back in August, 1984, I mentioned that a company called QEI, Inc., had acquired much of the old stock from the Northern Radio Company, manufacturers of some of the older RTTY gear. Unfortunately, a printer's gremlin scrambled their address. Write QEI at 60 Fadam Road, Springfield NJ 07081, if you like. Thanks and tip of the keyboard to Jeffrey Gornstein KD2BE for the correction.

Here's an item of interest for Spanish-speaking amateurs. The magazine *RTTY Journal* is now being published in Spanish, with Juan Rydzik LU4EGE as editor. If you are interested, drop them a note at *RTTY Journal* (Spanish edition), PO Box 64, 1706-Haedo, Buenos Aires, Argentina. Be sure to tell them you read about them in *73*'s "RTTY Loop," OK?

Until recently, when I used the term "mailbox" in this column, it referred to the place that I pick up the letters that you readers send me. But these days, mailbox has taken on an exciting new meaning. After the fashion of the telephone access BBSs, or bulletin board systems, put online by the computer crowd, these radio mailboxes, or MSOs, represent a new facet of RTTY.

CALLSIGN	FREQUENCY	SYSTEM	ACCESS	CITY	STATE
AJOX	14.087	HAL	?????	LAUREL	MS
KOKXR	3.626.0	????	KXRZW	VERMILLION	SD
KOVKH	14.087.7	HAL	MSOVKH	RAPID CITY	SD
KIVYQ	14.097.5	RATT	↓KIVYQ	RIDGEFIELD	CT
KB1S	14.087.7	HAL	MSOKB1S	WESTWOOD	MA
W1PW	14.097.5	CROWN	PWZW	MORGAN HILL	CA
N1BLB	14.097.5	CROWN	BLBZW	BLUE BELL	PA
W1CDM	14.097.5	MACRO	CDMZW	LEMON GROVE	CA
W1UKZ	14.085.0	RATT	↓W1UKZ	SCITUATE	MA
WA1IUF	14.097.5	MACRO	IUFZW	NEW HAVEN	CT
WB2IIF	14.080.0	MACRO	IIFZW	SPRINGLAKE HTS	NJ
AD4V	14.087.7	CUSTOM	MSOD4V	KNOXVILLE	TN
K4CJ	70.322.5	????	K4CJZW	LAKEMONT	GA
K4CZ	7.098.5	HAL	CIZW	LEXINGTON	KY
K4ILC	14.077.1	HAL	K4ILCZW	MIAMI	FL
K4KOZ	14.087.7	HAL	MSOKOZ	BOCA RATON	FL
K4PA	14.077.1	????	????	RESTON	VA
K4ZBG	14.077.1	MACRO	ZBGZW	FRESNO	CA
KA4V	14.077.1	MACRO	KA4VZW	FRANKLIN	NC
KE4TV	7.085.0	RATT	↓KE4TV	SAVANNAH	GA
W4XN	14.077.1	????	????	ALEXANDRIA	VA
WB4ZQB	7.087.7	HAL	MSOZQB	ROBBINSVILLE	NC
WD4MTC	14.087.7	HAL	MSOMTC	FORT MEYERS	FL
WD4SGU	14.087.7	CUSTOM	MSOSGU	FORT MEYERS	FL
K5FL	14.087.7	????	MSO5FL	DENTON	TX
WB5QXK	14.087.7	HAL	MSOQXK	RICHARDSON	TX
W5VXF	14.097.5	HAL	MSOVXF	HOUSTON	TX
WB5MXS	14.080.0	RATT	↓WB5MXS	MATAIRIE	LA
WB5NYA	14.087.0	HAL	MSONYA	MIDWEST CITY	OK
WD5BJQ	14.080.0	RATT	↓WD5BJQ	MATAIRIE	LA
KA6CDC	14.097.5	RATT	↓KA6CDC	HENDERSON	KY
KH6OD	14.097.5	RATT	↓KH6OD	JACKSON	MS
W6ZRR	14.087.0	HAL	MSOZRR	SAN LUIS OBISPO	CA
K7IFG	14.087.7	CUSTOM	MSOIFG	PORTLAND	OR
KV7G	14.087.7	CUSTOM	????	GLENROCK	WY
WB7QWG	14.097.5	CUSTOM	QWGZW	INDIANAPOLIS	IN
K8EWK	14.087.0	HAL	MSOEWK	COLUMBUS	OH
KB1F	10.145.0	RATT	↓KB1F	BRIGHTON	MI
KB2GZ	7.085.5	HAL	MSOZGZ	MANSFIELD	OH
KA8KYR	3.622.0	HAL	?????	MANISTIQUE	MI
WB8ICL	14.087.7	HAL	MSOICL	YELLOW SPRINGS	OH
WB8ZTV	3.635.0	HAL	MSOZTV	MOUNDSVILLE	WV
WD8CEB	7.091.0	CUSTOM	.CEBZ	FREMONT	OH
WD8LZZ	14.100.0	CUSTOM	MSOLZZ	MANSFIELD	OH
K9KUW	14.087.7	HAL	MSOKUW	KENNEY	IL
W9CD	14.087.7	HAL	MSO9CD	OLYMPIA FALLS	IL
W9JBM	14.087.7	HAL	MSOJBM	HOMEWOOD	IL
Foreign Stations					
VE3KPK	3.635.0	MACRO	????	ONTARIO	CANADA
VK2HL	14.097.5	MACRO	HLZW	DEE WHY	AUSTRALIA
VK2NY	14.097.5	MACRO	2NYZW	SYDNEY	AUSTRALIA
YV5CIV	7.040.0	MACRO	CIVZW	CARACAS	VENEZUELA
ZF1GC	14.097.5	MACRO	XFGC1ZW	GND CAYMAN	CAYMAN IS

Fig. 1. Mailbox listing.

Several months ago I mentioned one such MSO, run by Bob Kling K8GJL of Vandalia, Ohio. Bob states that he is running his over the local 146.25/146.85 repeater, with the cooperation of the repeater control station. For hardware, he is using a VIC-20 computer with a 16K expander. The MSO program is written in Basic and has storage for about 8K worth of messages. He has found this to be adequate for a local two-meter system, supporting about a dozen stations on RTTY. He is using an old tube-type terminal unit, made by Alltronics-Howard, and is keying the VIC-20 through an optoisolator. This proves what I have been preaching for some time—you don't need one of the fancy new demodulators to get on RTTY, especially not VHF RTTY where the "clear channel signal" abounds! Running a massive 500 mW with an old HR2B transceiver, the MSO has been on twenty-four hours a day without problems.

Another system up and running has been the one out in Santa Fe, New Mexico. The Santa Fe Amateur Radio Club has a repeater on 147.81/147.21 that is a backup for their main repeater on 146.22/146.82.

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The .81/.21 machine has been mostly quiet except for the RTTY tones of Alan Hill N5BGC and the bunch. As of the time he dropped me a note, he was still investigating programs to put on, using a VIC-20 as a control computer. Amateurs in the area might zip up to frequency and check it out.

Another group reaching out over the air is up in Manitoba, Canada. J. Gary Mills VE4CM in Winnipeg writes that a number of the hams in his area are experimenting with 1200-bps ASCII RTTY on two meters. The computer in use at VE4CM is a 6809 machine running Flex; others on the air include TRS-80s with modified ASCII terminal programs. It sounds like a lot of fun and may well develop into a high-tech RTTY network.

Now, here is the biggest list to date! Kris Torrey KA6VQI in Colton, California, sends along a list prepared for the Commodore Communicator. This BBS is no longer on line, Kris writes, because of poor software and board crashes. Anyway, he supplies the list shown in Fig. 1 which includes mailboxes across the United States, and a few foreign countries as well. I don't know how many of these MSOs are still up; this list was first compiled in October, 1983, but it is the most complete listing I have seen to date.

If you are running an MSO or working through one in your area, why not send the details along to me at the above address. I will keep some kind of record and try to publish an up-to-date list periodically.

Speaking of software, I receive a good number of letters each month asking for program suggestions for this or that computer. In the past, I have tried to answer them from whatever material is at hand from recent communications. I would like to try another way. This month, would each and every one of you who is using a TI-99/4 computer drop me a short note and let me know what kind of software you are using and what you think of it? It does not have to be a long letter, a postcard or QSL is fine. In coming months I will ask for other computers, giving some way to compile a sense of what is in use among RTTYers. If responses come in as expected, I should be able to report some information about three or four months after you see the question presented here. Thanks for your cooperation.

Thanks also for the interesting comments and questions to Russell F. Streeper WA4BWB, Lynchburg, Virginia, F. C. Horn WA4JPP, Jekyll Island, Georgia, Allen Kempke, Hancock, Michigan, and Gilbert Marazzini, Milan, Italy. I do appreciate hearing from you and I try to answer your questions as soon as possible. And for those of you who have asked, yes, there are still reprints of several back columns available. Drop me a line at the above address and enclose a self-addressed, *stamped* envelope for a listing of what is available. In the next "RTTY Loop," more responses to the information that you all tell me is the first that you read when your subscription issue of *73* arrives. Not a subscriber yet? Shame on you—you might miss the next "RTTY Loop!"

HAM HELP

I need a schematic for an Eico model 751 power supply. Also, how can I improve the frequency stability of an Eico model 753 triband transceiver? I will pay for postage and copying.

Patrick Banesch KB4EGJ
General Delivery
Loyall KY 40854

I would like to borrow the schematics and/or instruction manuals for the following Heathkit equipment: DX-35 transmitter, AR-3 receiver, and HD-20 XTAL calibrator. I will pay postage both ways.

Greg Magarie WA1VIL
33 Barnesdale Rd.
Natick MA 01760

I have inherited an FM VHF marine transceiver, the Aerotron Sealine, manufactured by Aeronautical Electronics, Inc., of Raleigh, North Carolina. They have moved and I was wondering if someone could help me locate them. I also am in need of its schematic and operator's manual. The info on it is FCC type 6W35/SLT-8, serial number 684756. I will gladly pay any cost incurred.

Frank B. Payne KD6DL
2712 Los Amigos Dr.
Rancho Cordova CA 95670

Can anybody supply a copy of the Eico 324 signal generator operations manual?

H. L. Church W9KXP
PO Box 126
Lebanon IL 62254-0126

I need a schematic and power transformer for an Ameco model PCL-P preamp.

T.H. Jenson KE6WE
910 Kelton St.
Tehachapi CA 93561

SATELLITES

USING THE AO-10 APOGEE PREDICTIONS

Apogee predictions for the month of January are provided for three sections of the United States: Washington DC at 39N 77W, Kansas at 39N 95W, and California at 38N 122W. Times are in UTC and apogee in this case is mean anomaly 128 rounded to the nearest whole hour. Use the chart as a guide in aiming your antenna, then fine-tune the azimuth and elevation values to peak the satellite's beacon signal. If you require more accurate orbital predictions, contact AMSAT at PO Box 27, Washington DC 20044.

AMSAT-OSCAR 10 APOGEE PREDICTIONS
JANUARY 1985

			WASH		KANSAS		CALIF	
ORBIT	DAY	TIME	AZ	EL	AZ	EL	AZ	EL
1168	1	0300					258	20
1169	1	1400	86	3				
1170	2	0200			268	8	250	30
1172	3	0100	274	4	262	18	241	40
1174	4	0000	267	13	255	28	228	49
1176	5	0000	262	16	248	30	218	49
1178	5	2300	254	26	238	39	200	56
1180	6	2200	246	35	226	48	176	58
1182	7	2200	238	37	216	48	167	55
1184	8	2100	226	46	197	54	146	52
1186	9	2000	210	53	175	57	128	46
1188	10	1900	189	58	152	55	115	38
1190	11	1900	178	55	146	50	113	32
1192	12	1800	156	54	129	44	103	24
1194	13	1700	137	49	116	37	94	15
1196	14	1700	132	44	113	31	93	9
1198	15	1600	119	36	103	22	85	1
1200	16	1500	107	28	95	14		
1201	17	0300					272	4
1202	17	1500	106	22	94	8		
1203	18	0200					266	14
1204	18	1400	97	14	85	0		
1205	19	0200					260	16
1206	19	1400	96	8				
1207	20	0100			271	4	253	26
1208	20	1300	88	0				
1209	21	0000	276	0	264	14	244	36
1213	22	2300	264	12	251	26	224	46
1215	23	2200	257	22	242	36	207	53
1217	24	2200	250	24	234	37	196	52
1219	25	2100	242	33	221	46	175	54
1221	26	2000	231	43	204	52	153	53
1223	27	2000	222	43	194	51	147	48
1225	28	1900	206	50	173	53	130	42
1227	29	1800	186	54	153	51	117	35
1229	30	1700	164	54	135	46	107	26
1231	31	1700	156	50	131	40	105	20

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73 Amateur Radio's Technical Journal

W2NSD/1
NEVER SAY DIE
editorial by Wayne Green

from page 4

this work. With six DXpeditions per year, that would call for around 70 hams interested in investing $3,000 each for the trip of a lifetime. I know I'd get oversubscribed if I asked for Japanese volunteers, but do we have even half that many American hams interested in going on DXpeditions?

Where to? Rare spots—perhaps Iraq, China, Macao, Sarawak, Brunei, Sabah, Lesotho, Swaziland, Fiji, New Caledonia, Western Samoa—there are lots of rare spots which are exciting to visit. I've been in all of the above and operated from most of 'em, so I know they're fascinating places for visiting and for DXing.

You know, if I could get letters from at least 50 readers willing to sign up for one week of excitement—the memories of a lifetime—I'd start setting up some trips, getting the portable ham gear and the video equipment we'd need to turn out some broadcast-quality tapes. Some of the going can be rough, so no weak hearts or backs, okay?

How'd you like to get away for a week to some out-of-the-way corner of the world, yet be able to travel on jets and stay at first-class hotels? You'd be on the hot end of the pileups, keeping your log on a picocomputer which would automatically check for duplicate contacts, print the log, and even print QSL cards later on! It would also let you know how many contacts you've made with how many countries, how many prefixes, zones, and so on.

No, we won't be going to places where we'll get shot at, like Spratly.

Are you game?

AWARDS

Bill Gosney KE7C
Micro-80, Inc.
2665 North Busby Road
Oak Harbor WA 98277

THE AWARDS PROGRAM OF *73: AMATEUR RADIO'S TECHNICAL JOURNAL*

It's been six years since the initial announcement of the *73* Awards Program. Since its introduction in 1979, we've seen the program grow to become one of the most popular challenges facing amateurs today.

Consisting of six domestic and five DX operating achievements, the program has captured the interest of rag-chewers, DXers, and contesters alike.

The requirements are not as easy as one might first imagine. Once you qualify for a *73* award, you know you've earned it. Last month we featured the six domestic awards. Now, here are the five DX awards:

WORK THE WORLD DX AWARD

To enhance the enjoyment of working DX, the editors of *73* take special pleasure in introducing the most complex and probably one of the most sought-after DX awards available today—the Work the World DX Award.

1. The WTW Award is available to licensed amateurs and SWL stations worldwide.

2. To be valid, all contacts must be made on or after January 1, 1979. There are no band or mode restrictions. Special single-band or -mode achievements may be recognized if you make your request at the same time application is made.

3. The Work the World program consists of six individual continental awards (North American, South American, European, Oceanic, Asian, and African), each of which is a worthy single accomplishment of its own. To be eligible for the 7th and ultimate award (the WTW Award), applicants first earn the continental recognition. Once all six awards have been applied for, the WTW award will be issued to the applicant at no charge. The operator who earns WTW recognition has truly "worked the world."

4. Requirements for the individual continental awards: North American Award—a minimum of 13 North American countries; South American Award—12 South American countries minimum; European Award—a minimum of 12 European countries; African Award—12 African countries minimum; Asian Award—12 Asian countries minimum; Oceanic Award—a minimum of 12 Oceanic countries.

5. To apply, prepare a list of claimed contacts for each continent. List contacts in prefix order. Include the date and time in GMT and the band and mode of operation.

6. If you are submitting your sixth (6th) continental award, please alert the Awards Manager to this fact.

7. *Do not send QSL cards*! Have your

AWARD RECIPIENTS
(as of 9-1-84)
WORK THE WORLD AWARD

177.	FM7WD	194.	WB3BVL
178.	ZS6FL	195.	4Z4VG
179.	WB6TJW	196.	VE7DRI
180.	VE6CNV	197.	K2NT
181.	N2CBU	198.	I2YJO
182.	I8QLI	199.	I2KKL
183.	OZ-DR1239	200.	WD0AVG
184.	OE3HPA	201.	JR3AKG
185.	HK5CKH	202.	N7AHQ
186.	KD7ET	203.	IS0KNG
187.	IK1AOD	204.	YB0ZM
188.	W5RKK	205.	OZ1ACB
189.	WB5YPE	206.	DA1WJ
190.	WB2DHY	207.	JA1KRU
191.	KS1L	208.	YB0BZZ
192.	W6BCQ	209.	JA9GXY
193.	P29NSF		

AWARD RECIPIENTS
(as of 9-1-84)
AFRICAN AWARD

235.	FM7WD	264.	OZ5EDR
236.	ZS6FL	265.	I2YJO
237.	VE3-9094	266.	I2KKL
238.	JR7ICN	267.	KA2PHQ
239.	N4GQO	268.	JF2MVI
240.	KB2VO	269.	ZS6BWW
241.	LA4VL	270.	ZS6BWP
242.	OZ1ACB	271.	WD0AVG
243.	WB6TJW	272.	JR3AKG
244.	JY9CW	273.	JA3CJL
245.	N2CBU	274.	IT9GFE
246.	I8QLI	275.	IS0KNG
247.	IK1AOD	276.	YB0ZM
248.	W5RKK	277.	KA1CLV
249.	WB5YPE	278.	N7AHQ
250.	DA1WJ	279.	JA2-8964
251.	OE3HPA	280.	YC0EBS
252.	HK5CKH	281.	JH1DLJ
253.	KD7ET	282.	JJ1EEA
254.	5B4MF	283.	CT1AUO
255.	WB2DHY	284.	JH1KKT
256.	KS1L	285.	JA1KRU
257.	W6BCQ	286.	JH3CBN
258.	K2NT	287.	SM6DUA
259.	YB0BZZ	288.	JA9GXY
260.	VE7DRI	289.	JR6DQC
261.	OE3HCS	290.	JA8RII
262.	YS9HH	291.	PY2CXH
263.	PY2DBU		

AWARD RECIPIENTS
(as of 9-1-84)
EUROPEAN AWARD

350.	FM7WD	385.	KA2PHQ
351.	ZS6FL	386.	PY2FDO
352.	VE3-9094	387.	JF2MVI
353.	N4GQO	388.	KY6I
354.	VQ9JW	389.	YC0EBS
355.	LA4VL	390.	CT1AUO
356.	WB6TJW	391.	JR3AKG
357.	WA9AEA	392.	HC2DQ
358.	WL7F	393.	YC5RJ
359.	N2CBU	394.	JA3CJL
360.	ZS6BWW	395.	IS0KNG
361.	I8QLI	396.	YB0ZM
362.	IK1AOD	397.	JP1FEE
363.	YB0BZZ	398.	JH7XRB
364.	W5RKK	399.	JR3KAH
365.	WB5YPE	400.	JH1FTS
366.	DA1WJ	401.	OZ7HVI
367.	OE3HPA	402.	JF2AFJ
368.	PY2TRD	403.	JE2GJD
369.	PY2DBU	404.	JR1RMY
370.	KD7ET	405.	JA2-8964
371.	N7EQT	406.	JA1KRU
372.	5B4MF	407.	JH3CBN
373.	WB2DHY	408.	SM6DUA
374.	YS9HH	409.	JA9GXY
375.	KS1L	410.	JF1VXB
376.	W6BCQ	411.	JR6DQC
377.	P29NSF	412.	JR1DTN
378.	YB5NA	413.	JA8RII
379.	K2NT	414.	HL1ACW
380.	OE3HCS	415.	JG1HXC
381.	YC5QZ	416.	PY2CXH
382.	Hoiss—SWL	417.	DU7EV
383.	I2YJO	418.	JR7EQL
384.	I2KKL		

AWARD RECIPIENTS
(as of 9-1-84)
SOUTH AMERICAN AWARD

269.	KB2VO	295.	W6BCQ
270.	OZ-DR1239	296.	P29NSF
271.	PY2SZK	297.	5B4MF
272.	N4GQO	298.	K7DBV
273.	JR7ICN	299.	VE7DRI
274.	VE3-9094	300.	K2NT
275.	ZS6FL	301.	I2YJO
276.	FM7WD	302.	I2KKL
277.	WP4ATF	303.	KA2PHQ
278.	WB6TJW	304.	KA5BQM
279.	WA9AEA	305.	WB2VTD
280.	N2CBU	306.	CT1AUO
281.	OZ5EDR	307.	JR3AKG
282.	I8QLI	308.	HC2DQ
283.	DA1WJ	309.	OZ1ACB
284.	OE3HPA	310.	YB0BZZ
285.	KY6I	311.	YB0ZM
286.	PY2DBU	312.	IS0KNG
287.	KD7ET	313.	JA1KRU
288.	IK1AOD	314.	K2YOF
289.	N2EGR	315.	JH3CBN
290.	W5RKK	316.	JA9GXY
291.	WB5YPE	317.	PY2CXH
292.	WB2DHY	318.	PY1DEA
293.	YS9HH	319.	XE1JIW
294.	KS1L		

AWARD RECIPIENTS
(as of 9-1-84)
ASIAN AWARD

207.	LA4VL	232.	4Z4VG
208.	VQ9JW	233.	OE3HCS
209.	VE6CNV	234.	VE7DRI
210.	VE3-9094	235.	K2NT
211.	ZS6FL	236.	I2YJO
212.	FM7WD	237.	I2KKL
213.	WB6TJW	238.	KA2PHQ
214.	N2CBU	239.	JF2MVI
215.	JY9CW	240.	VE7EDA
216.	I8QLI	241.	JR3AKG
217.	IK1AOD	242.	JA3CJL
218.	YB0BZZ	243.	IS0KNG
219.	W5RKK	244.	YB0ZM
220.	WB5YPE	245.	JA2-8964
221.	DA1WJ	246.	JR1RMY
222.	OE3HPA	247.	OZ7HVI
223.	HK5CKH	248.	YC0EBS
224.	N7AHQ	249.	JA1KRU
225.	JR6GSE	250.	JH3CBN
226.	KD7ET	251.	SM6DUA
227.	WB2DHY	252.	JA9GXY
228.	KS1L	253.	WA1UDH
229.	W6BCQ	254.	PY2CXH
230.	P29NSF	255.	PY2DBU
231.	5B4MF		

list of contacts verified by two amateurs or a notary public.

8. The fee for each continental award is $5.00 in US funds only. We are sorry, but we can no longer accept IRCs or foreign currency. Checks written on foreign banks must be payable in US funds.

9. Forward your application(s) and fee(s) to: Bill Gosney KE7C, *73* Awards Manager, 2665 N. Busby Road, Oak Harbor WA 98277, USA.

73 DX COUNTRY CLUB AWARD

1. Available to licensed amateurs and SWL stations worldwide.

2. To be valid, all claimed contacts must be made in a single calendar year (January 1 through December 31), beginning January 1, 1979.

3. This award is issued for phone, CW, and mixed modes. Should the applicant wish to recognize a single-band or mixed-band accomplishment, the preference must be stated when making the application.

4. A minimum of seventy-three (73) DX countries must be worked and confirmed from the *73* WTW (Work the World) DX listing.

5. Annual endorsement stickers are available for each succeeding year in which application is made and a minimum of 73 DX countries are worked.

6. To apply, prepare a list of claimed contacts in prefix order. Include each station's callsign, date and time of contact in GMT, mode, and band of operation.

7. *Do not send QSL cards.* Have your list of contacts verified by two amateurs or a notary public.

8. Award fee is now $5.00. Endorsements are granted for a fee of $2.50. Do not send IRCs or foreign currency; they can no longer be accepted. Checks on foreign banks must be payable in US funds.

9. Forward your application and fee to: Bill Gosney KE7C, *73* Awards Manager, 2665 N. Busby Road, Oak Harbor WA 98277, USA.

AWARD RECIPIENTS
(as of 9-1-84)
NORTH AMERICAN AWARD

296.	FM7WD	317.	W6BCQ
297.	ZS6FL	318.	P29NSF
298.	VE3-9994	319.	K2NT
299.	JR7ICN	320.	OE3HCS
300.	N4GQO	321.	VE5ADO
301.	KB2VO	322.	YS9HH
302.	WB6TJW	323.	I2YJO
303.	WA9AEA	324.	I2KKL
304.	N2CBU	325.	KA2PHQ
305.	PY2DBU	326.	CT1AUO
306.	I8QLI	327.	JR3AKG
307.	DA1WJ	328.	IT9GFE
308.	OE3HPA	329.	IS0KNG
309.	KY6I	330.	YB0ZM
310.	KD7ET	331.	JA1KRU
311.	IK1AOD	332.	YB0BZZ
312.	N2EGR	333.	SM6DUA
313.	W5RKK	334.	JA9GXY
314.	WB5YPE	335.	VE7EDA
315.	WB2DHY	336.	XE1JIW
316.	KS1L	337.	HC2DQ

AWARD RECIPIENTS
(as of 9-1-84)
OCEANIC AWARD

223.	KA2JJK	250.	JF2MVI
224.	K7DBV	251.	PY2DBU
225.	ZS6LF	252.	DA1WJ
226.	FM7WD	253.	WD0AVG
227.	WB6TJW	254.	JR3AKG
228.	KA6HTC	255.	JA3CJL
229.	N2CBU	256.	IS0KNG
230.	I8QLI	257.	YB0ZM
231.	IK1AOD	258.	WA1UDH
232.	YB0BZZ	259.	OZ1ACB
233.	W5RKK	260.	JA2-8964
234.	WB5YPE	261.	JH3CBN
235.	OE3HPA	262.	KA1KRU
236.	KD7ET	263.	KC9XL
237.	VE7EDA	264.	JF2AFJ
238.	WB2DHY	265.	JE2GJD
239.	KS1L	266.	JR1RMY
240.	W6BCQ	267.	W2-6893
241.	P29NSF	268.	JA9GXY
242.	WB3BVL	269.	W0IKD
243.	JK1PTQ	270.	K7PRH
244.	YS9HH	271.	I8HZT
245.	4Z4VG	272.	HL1ACW
246.	VE7DRI	273.	KH6JOI
247.	K2NT	274.	XE1JIW
248.	I2YJO	275.	I8JKN
249.	I2KKL		

AWARD RECIPIENTS
(as of 9-1-84)
SPECIALTY COMMUNICATIONS AWARD (Class A-1)

29. 5Z4DA(RTTY)
30. W9HR(OSCAR)
31. IK1AOD(RTTY)
32. I1BRB(OSCAR)
33. YC0EBS(RTTY)
34. YB0ZM(RTTY)

SPECIALTY COMMUNICATIONS ACHIEVEMENT AWARD (CLASS A-1)

1. This award has become very popular, especially with the advent of the new OSCAR satellite and the widespread use of personal computers for RTTY. It is made available to licensed amateurs and SWL stations throughout the world.

2. To be eligible, all contacts must be made on or after January 1, 1979. Only communications via SSTV, RTTY, EME (Earth-moon-Earth), and/or OSCAR will be recognized for award credit. Contacts between stations on OSCAR and EME may be made using the mode authorized in your country. Mixed-mode contacts are not valid, however.

3. To qualify, applicants must work a minimum of ten (10) DX countries from the WTW DX Countries listing. Special recognition will be made for those exceeding the ten-country minimum.

4. To apply, the applicant must prepare a list of claimed contacts in callsign prefix order. Include the date and time in GMT, the band and mode of operation, and a description of your equipment and antenna system used to make the contacts.

5. *Do not send QSL cards.* Have your list of contacts verified by two amateurs or a notary public.

6. The award fee is now $5.00 in US funds only. IRCs or foreign currency is not acceptable. Foreign checks must be payable in US funds.

7. Forward your application and award fee to: Bill Gosney KE7C, *73* Awards Manager, 2665 N. Busby Road, Oak Harbor WA 98277, USA.

AWARD RECIPIENTS
(as of 9-1-84)
DX CAPITALS OF THE WORLD AWARD

31.	W2-6893	36.	FM7WD
32.	I8HZT	37.	YB0ZM
33.	JA1VDJ	38.	WA8KMK
34.	SV1MO	39.	JH3CBN
35.	KI2G	40.	JJ1EEA

DX CAPITALS OF THE WORLD

1. This award is made available to licensed amateurs and SWL stations throughout the world.

2. All claimed contacts must be made on or after January 1, 1979. There are no band or mode restrictions. Special recognition will be given for single band or mode if requested at the time application is made.

3. To qualify, applicants must work and confirm a minimum of fifty (50) different national capital cities in the world. Only capital cities of those countries appearing on the WTW DX listing qualify. Should a country be contacted whose capital city is not commonly known, go ahead and list it in your application. The awards editor reserves the right to make a final determination.

4. To apply, make a list of contacts made in prefix order. Indicate the station callsign, date and time in GMT, band and mode of operation, the name of the national capital city, and the DX country.

5. *Do not send QSL cards.* Have your list of contacts verified by two amateurs or a notary public.

AWARD RECIPIENTS
(as of 9-1-84)
TEN METER DX DECADE AWARD

12.	KA3FUU	16.	DA2ZF
13.	W2-6893	17.	I7ZQE
14.	KD5VR	18.	WB3LTT
15.	DA1WJ		

AWARD RECIPIENTS
(as of 9-1-84)
THE ANNUAL 73 DX COUNTRY CLUB AWARD

SSB		154.	IK0AZG(83)
134.	WA1SMI(82)	155.	IS0KNG(83)
135.	W3BHM(81)	156.	PY2WE(81)
136.	K4JDJ(83)	157.	OE3WQB(83)
137.	VP2MO(81)	158.	DJ7MD(84)
138.	YB0BZZ(83)	**CW**	
139.	W5RKK(83)	22.	OZ5EDR(82)
140.	WB5YPE(83)	23.	PT2ACZ(82)
141.	YB0ZM(81)	24.	KK4Y(82)
142.	OE3HCS(83)	25.	PY2FK(82)
143.	WA1SMI(83)	26.	VQ9JW(83)
144.	KE7C(81)	**Mixed Mode**	
145.	KE7C(82)	25.	KA9MMD(82)
146.	KE7C(83)	26.	W2GVX(82)
147.	KA2PHQ(83)	27.	W9CC(82)
148.	DJ7MD(83)	28.	JH7VHZ(82)
149.	4Z4PS(83)	29.	LA4VL(82)
150.	KZ9A(83)	30.	FM7WD(83)
151.	IT9GFE(83)	31.	DL5LAG(83)
152.	OZ1ACB(83)	32.	KS1L(83)
153.	IK6BOB(83)		

6. Award fee is $5.00 and must be payable in US funds. We are sorry, IRCs or foreign currency can no longer be accepted.

7. Forward your application and award fee to: Bill Gosney KE7C, *73* Awards Manager, 2665 N. Busby Road, Oak Harbor WA 98277, USA.

TEN-METER DX DECADE AWARD

1. The 10-Meter DX Decade Award is made available to licensed amateurs and SWL stations worldwide.

2. All contacts must be made on the 10-meter band using only low-power

1-2-3 GO

Nominate A Winner For Dayton HAMVENTION '85

1. For RADIO AMATEUR OF THE YEAR
   This person should be an all-around outstanding radio amateur who has made significant contributions to our hobby over an extended period of time.
2. For SPECIAL ACHIEVEMENT
   This person should be a radio amateur of any rank who has accomplished a one-time outstanding achievement such as in emergency work, DXpedition, moon bounce, QRP, etc.
3. For TECHNICAL EXCELLENCE
   This person should be an amateur who has made some outstanding accomplishments in a technical area of our hobby.

Deadline for submission is April 1, 1985.

For additional information write:

AWARDS COMMITTEE
1985 Dayton HAMVENTION
P.O. Box 44
Dayton, Ohio 45401

See List of Advertisers on page 80

WTW DX LISTING

NORTH AMERICA

C6	Bahamas
CO	Cuba
FG	Guadeloupe
FG, FS	Saint Martin
FM	Martinique
FO	Clipperton Is.
FP	St. Pierre & Miquelon
HH	Haiti
HI	Dominican Republic
J3, VP2G	Grenada & Dependencies
KC4, KP1	Navassa Is.
KG4	Guantanamo Bay
KL7	Alaska
KP4	Desecheo
KP4	Puerto Rico
KS4, KP3, HK0	Serrana Bank and Roncador Cay
KV, KP2	Virgin Islands
OX, XP	Greenland
PJ6, 8	Saba Is.
VE	Canada
VE1	Sable Is.
VE1	St. Paul Is.
VO	Newfoundland, Labrador
VP2A	Antigua, Barbuda
VP2D	Dominica
VP2E	Anguilla
VP2K	St. Kitts
VP2L	St. Lucia
VP2M	Montserrat
VP2S	St. Vincent & Dependencies
VP2V	British Virgin Islands
VP5	Turks and Calcos Islands
VP9	Bermuda
W, K, N, A	United States of America
XE	Mexico
XF4	Revillagigedo Islands
ZF	Grand Cayman Islands
6Y	Jamaica
4U	HQ, United Nations
8P	Barbados

SOUTH AMERICA

CE	Chile
CE0A	Easter Is.
CE0X	San Felix
CE0Z	Juan Fernandez
CP	Bolivia
CX	Uruguay
FY	French Guiana
HC	Ecuador
HC8	Galapagos Is.
HK	Colombia
HK0	Bajo Nuevo
HK0	Malpelo Is.
HK0	San Andres & Providencia
HP	Panama
HR	Honduras
HR0	Swan Is.
KZ	Canal Zone
LU	Argentina
OA	Peru
PJ	Bonaire
PJ	Netherlands Antilles
PY	Brazil
PY0	Fernando de Noronha
PY0	St. Peter & St. Paul
PY0	Trinidade & Martim Vaz Is.
PZ	Surinam
TG	Guatemala
TI	Costa Rica
TI0	Cocos Is.
VP1	Belize
VP8	Falkland Is.
VP8, LU	South Georgia Is.
VP8, LU	South Orkney Is.
VP8, LU	South Sandwich Is.
VP8, LU	South Shetland Is.
VP8W	South Grahamland
YN	Nicaragua
YS	Salvador
YV	Venezuela
YV0	Aves Is.
ZP	Paraguay
8R	Guyana
9Y	Trinidad and Tobago

EUROPE

C3	Andorra
CT	Portugal
CT2	Azores
DA-DL	Federal Republic of Germany
DM, DT	German Democratic Republic
EA	Spain
EA6	Balearic Islands
EI	Republic of Ireland
EJ8	Aran Is.
F	France
FC	Corsica
G	England
GD	Isle of Man
GI	Northern Ireland
GJ, GC	Jersey
GM	Scotland
GM	Orkney Islands
GM	Shetland Islands
GU, GC	Guernsey
GW	Wales
HA	Hungary
HB	Switzerland
HB0	Liechtenstein
HV	Vatican
I	Italy
IC	Ischia
IA	Tuscan Archipelago
IS	Sardinia
IT	Sicily
JW	Bear Is.
JW	Svalbard Is.
JX	Jan Mayen
LA	Norway
LX	Luxembourg
LZ	Bulgaria
M1	San Marino
OE	Austria
OH	Finland
OH0	Aland Is.
OJ0	Market Reef
OK	Czechoslovakia
ON	Belgium
OY	Faeroe Islands
OZ	Denmark
PA	Netherlands
SM	Sweden
SP	Poland
SV	Greece
SV	Crete
SV	Dodecanese
SV	Mount Athos
TF	Iceland
UA, UK1, 3, 4, 6	European RSFSR
UA1, UK1	Franz Josef Land
UA2, UK2F	Kaliningradsk
UB, UK, UT, UY5	Ukraine
UC2, UK2	White RSFSR
UO5, UK5O	Moldavia
UP2, UK2B, P	Lithuania
UQ2, UK2G, Q	Latvia
UR2, UK2R, T	Estonia
YO	Romania
YU	Yugoslavia
ZA	Albania
ZB	Gibraltar
3A	Monaco
4U	ITU, Geneva
9A	(See M1)

ASIA

A4X	Oman Is.
A5	Bhutan
A6X	United Arab Emirates
A7X	Qatar
A9X	Bahrain
AP	Pakistan
BV	Taiwan
BY	China
CR9	Macao
EP	Iran
HL, HM	North Korea
HL, HM	South Korea
HS	Thailand
HZ, 7Z	Saudi Arabia
JA-JR	Japan
JR6, KA6	Okinawa (Ryukyu Is.)
JD, KA1	Ogasawara
JT	Mongolia
JY	Jordan
KA	US Military in Japan
OD	Lebanon
S2	Bangladesh
TA	Turkey
UA, UK, UV	Asiatic RSFSR
UW9-0	Asiatic RSFSR
UD6, UK6C, D, K	Azerbaidzhan
UF6, UK6F, O, Q, V	Georgia
UG6, UK6G	Armenia
UH8, UK8H	Turkoman
UI8, UK8I	Uzbek
UJ8, UK8J, R	Tadzhik
UL7, UK7	Kazakh
UM8, UK8M, N	Kirghiz
VS6	Hong Kong
VS9K	Kamaran Is.
VU	India
VU7	Andaman & Nicobar
VU7	Laccadives
XU	Khmer Republic
XV	Vietnam
XW	Laos People's Dem. Rep.
XZ	Burma
YA	Afghanistan
YI	Iraq
YK	Syria
1S	Spratly
4S	Sri Lanka
4W	Yemen
4X, 4Z	Israel
5B4, ZC	Cyprus
7O	People's Dem. Rep. of Yemen
8Z4	Neutral Zone
	Saudi Arabia/Iraq
9H	Malta
9H4	Gozo & Comino
9K	Kuwait
9M2	West Malaysia
9M6	North Borneo
9M8	Sarawak
9N	Nepal
9V	Singapore
	Abu Ail, Jabal Attair

OCEANIA

A3	Tonga Republic
CR8	Portuguese Timor
C2	Republic of Nauru
DU	Philippines
FK	New Caledonia
FO	French Polynesia
FW	Wallis & Fortuna Islands
H4, VR4	Solomon Islands
JD, KA1	Minami Torishima
JD, 7J1	Okino Torishima
KB, KH1	Baker, Howland, American Phoenix
KC6	Eastern Carolines
KC6	Western Carolines
KG6, KH2	Guam Island
KG6R	Rota
KG6S	Saipan
KG6T	Tinian
KH6	Hawaiian Islands
KH7	Kure Island
KJ, KH3	Johnston Island
KM, KH4	Midway Island
KP6, KH5K	Kingman Reef
KP6, KH5	Palmyra
K5S, KH8	American Samoa
KW, KH9	Wake Island
KX	Marshall Islands
P2	Papua, New Guinea
T2, VR8	Tuvalu Island
VK	Australia
VK	Lord Howe Island
VK9	Willis Island
VK9	Christmas Island
VK9	Keeling, Cocos Island
VK9	Mellish Reef
VK9	Norfolk Island
VK9	Macquarie Island
VR1	British Phoenix Islands
VR1	Gilbert Island
VR1	Ocean Island
VR3	Christmas Island
VR6	Pitcairn Island
VR7	Line Island, South and Central
VR8	(See T2)
VS5	Brunei
YB, YC, YD	Borneo
YB, YC, YD	Celebes
YB, YC, YD	Java
YB, YC, YD	Sumatra
YB, YC, YD	West Irian
YJ	New Hebrides
ZK1	North Cook Island
ZK1	South Cook Island
ZK2	Niue Island
ZL	New Zealand
ZL	Auckland & Campbell
ZL	Chatham Island
ZL	Kermadec
ZM7	Tokelaus
3D2	Fiji Islands
5W	Western Samoa

AFRICA

A2	Botswana
C5	Gambia
C9	Mozambique
CN	Morocco
CN2	Tangier
CR3	Guinea Bissau
CT3	Madeira Is.
D2, 3	Angola
D4	Republic of Cape Verde
D6	Comoros
EA8	Canary Islands
EA9	Ceuta and Melilla
EA9	Ifni
EA9	Rio de Oro
EL	Liberia
ET2	Eritrea
ET3	Ethiopia
FB8W	Crozet
FB8X	Kerguelen Is.
FB8Z	Amsterdam & St. Paul
FH	Mayotte
FR	Glorioso Island
FR	Juan de Nova, Europa
FR	Reunion
FR	Tromelin
H5	Bophuthatswana
IG	Lampedusa Island
IH	Pantelleria Island
J2, FL8	Djibouti
S7	Seychelles
S8	Transkei
S9	Sao Tome and Principe
ST	Sudan
ST0	South Sudan
SU	Egypt
TJ	Cameroon
TL	Central African Empire
TN	Congo
TR	Gabon
TT	Chad
TU	Ivory Coast
TY	Benin
TZ	Mali
VK0	Heard Island
VQ9	Aldabra Island
VQ9	Chagos (Diego Garcia)
VQ9	Desroches
VQ9	Farquhar
XT	Upper Volta
ZD7	St. Helena
ZD8	Ascension Island
ZD9	Gough Island and Tristan da Cunha
ZE	Rhodesia
ZS1, 2, 4, 6	South Africa
ZS2	Prince Edward Island
ZS2	Marion Island
ZS3	Southwest Africa (Namibia)
3B6, 7	Agalega & St. Brandon
3B8	Mauritius
3B9	Rodriguez Island
3C	Equatorial Guinea
3D6	Swaziland
3V	Tunisia
3X	Republic of Guinea
3Y	Bouvet Island
5A	Libya
5H	Tanzania
5N	Nigeria
5R	Malagasy Republic
5T	Mauritania
5U	Niger
5V	Togo
5X	Uganda
5Z	Kenya
6O	Somali
6W	Senegal
7P	Lesotho
7Q	Malawi
7X	Algeria
8Q, VS9	Maldive Islands
9G	Ghana
9J	Zambia
9L	Sierra Leone
9Q	Republic of Zaire
9U	Burundi
9X	Rwanda

equipment (20 Watts output or less). External amplifiers may not be used.

3. To be eligible, all contacts must be made on or after October 1, 1978. Contacts may be made on AM, SSB, CW, or 10-meter FM. Mixed-mode contacts may also be claimed. Crossmode contacts do not qualify.

4. To qualify, a minimum of ten (10) DX countries must be worked, from the WTW DX listing. Endorsements will be given for 25, 50, 75, and 100 confirmed countries.

5. To apply, prepare a list of claimed contacts in prefix order. Include the call-sign of each station worked, the date and time in GMT, band, mode, and a brief description of the equipment used in making each contact.

6. *Do not send QSL cards.* Have your application verified by two amateurs or a notary public.

7. Award fee is $5.00 in US funds only. Endorsements are $2.50 each. Sorry, we cannot accept IRCs or foreign currency.

8. Forward your application and award fee to: Bill Gosney KE7C, *73* Awards Manager, 2665 N. Busby Road, Oak Harbor WA 98277, USA.

HAM HELP

I am looking for clear-cut information on building or buying TV-receive equipment for the low 6-GHz range.

Eugene Hertel
RR2 Hillcrest Dr.
Garden City KS 67846

I need a manual for a Collins 75A2 or 75A2A. I will pay reproduction and shipping costs.

Ken Kolthoff K8AXH/0
#2 Copper Corral
Plattsmouth NE 68048

TUBES

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
2C39/7289	$ 34.00	1182/4600A	$500.00	ML7815AL	$ 60.00
2E26	7.95	4500A	500.00	7843	107.00
2K28	200.00	4624	310.00	7854	130.00
3-500Z	102.00	4657	84.00	ML7855KAL	125.00
3-1000Z/8164	400.00	4662	100.00	7984	14.95
3B28/866A	9.50	4665	500.00	8072	84.00
3CX400U7/8961	255.00	4687	P.O.R.	8106	5.00
3CX1000A7/8283	526.00	5675	42.00	8117A	225.00
3CX3000F1/8239	567.00	5721	250.00	8121	110.00
3CW30000H7	1700.00	5768	125.00	8122	110.00
3X2500A3	473.00	5819	119.00	8134	470.00
3X3000F1	567.00	5836	232.50	8156	12.00
4-65A/8165	69.00	5837	232.50	8233	60.00
4-125A/4D21	79.00	5861	140.00	8236	35.00
4-250A/5D22	98.00	5867A	185.00	8295/PL172	500.00
4-400A/8438	98.00	5868/AX9902	270.00	8458	35.00
4-400B/7527	110.00	5876/A	42.00	8462	130.00
4-400C/6775	110.00	5881/6L6	8.00	8505A	95.00
4-1000A/8166	444.00	5893	60.00	8533W	136.00
4CX250B/7203	54.00	5894/A	54.00	8560/A	75.00
4CX250FG/8621	75.00	5894B/8737	54.00	8560AS	100.00
4CX250K/8245	125.00	5946	395.00	8608	38.00
4CX250R/7580W	90.00	6083/AZ9909	95.00	8624	100.00
4CX300A/8167	170.00	6146/6146A	8.50	8637	70.00
4CX350A/8321	110.00	6146B/8298	10.50	8643	83.00
4CX350F/8322	115.00	6146W/7212	17.95	8647	168.00
4CX350FJ/8904	140.00	6156	110.00	8683	95.00
4CX600J/8809	835.00	6159	13.85	8877	465.00
4CX1000A/8168	242.50*	6159B	23.50	8908	13.00
4CX1000A/8168	485.00	6161	325.00	8950	13.00
4CX1500B/8660	555.00	6280	42.50	8930	137.00
4CX5000A/8170	1100.00	6291	180.00	6L6 Metal	25.00
4CX10000D/8171	1255.00	6293	24.00	6L6GC	5.03
4CX15000A/8281	1500.00	6326	P.O.R.	6CA7/EL34	5.38
4CW800F	710.00	6360/A	5.75	6CL6	3.50
4D32	240.00	6399	540.00	6DJ8	2.50
4E27A/5-125B	240.00	6550A	10.00	6DQ5	6.58
4PR60A	200.00	6883B/8032A/8552	10.00	6GF5	5.85
4PR60B	345.00	6897	160.00	6GJ5A	6.20
4PR65A/8187	175.00	6907	79.00	6GK6	6.00
4PR1000A/8189	590.00	6922/6DJ8	5.00	6HB5	6.00
4X150A/7034	60.00	6939	22.00	6HF5	8.73
4X150D/7609	95.00	7094	250.00	6JG6A	6.28
4X250B	45.00	7117	38.50	6JM6	6.00
4X250F	45.00	7203	P.O.R.	6JN6	6.00
4X500A	412.00	7211	100.00	6JS6C	7.25
5CX1500A	660.00	7213	300.00*	6KN6	5.05
KT88	27.50	7214	300.00*	6KD6	8.25
416B	45.00	7271	135.00	6LF6	7.00
416C	62.50	7289/2C39	34.00	6LQ6 G.E.	7.00
572B/T160L	49.95	7325	P.O.R.	6LQ6/6MJ6 Sylvania	9.00
592/3-200A3	211.00	7360	13.50	6ME6	8.90
807	8.50	7377	85.00	12AT7	3.50
811A	15.00	7408	2.50	12AX7	3.00
812A	29.00	7609	95.00	12BY7	5.00
813	50.00	7735	36.00	12JB6A	6.50

NOTE * = USED TUBE

NOTE P.O.R. = PRICE ON REQUEST

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"FILTERS"

COLLINS Mechanical Filter #526-9724-010 MODEL F455Z32F

455KHZ at 3.2KHz wide. May be other models but equivalent. May be used or new. $15.99

ATLAS Crystal Filters

5.595-2.7/8/LSB, 5.595-2.7/LSB
8 pole 2.7KHz wide Upper sideband. Impedence 800ohms 15pf In/800ohms 0pf out. 19.99

5.595-2.7/8/U, 5.595-2.7/USB
8 pole 2.7Khz wide Upper sideband. Impedence 800ohms 15pf In/800ohms 0pf out. 19.99

5.595-.500/4, 5.595-.500/4/CW
4 pole 500 cycles wide CW. Impedance 800ohms 15pf In/800ohms 0pf out. 19.99

9.0USB/CW
6 pole 2.7KHz wide at 6dB. Impedance 680ohms 7pf In/300ohms 8pf out. CW-1599Hz 19.99

KOKUSAI ELECTRIC CO. Mechanical Filter #MF-455-ZL/ZU-21H

455KHz at Center Frequency of 453.5KC. Carrier Frequency of 455KHz 2.36KC Bandwidth.
Upper sideband. (ZU) 19.99
Lower sideband. (ZL) 19.99

CRYSTAL FILTERS

NIKKO	FX-07800C	7.8MHz	$10.00
TEW	FEC-103-2	10.6935MHz	10.00
SDK	SCH-113A	11.2735MHz	10.00
TAMA	TF-31H250	CF 3179.3KHz	19.99
TYCO/CD	001019880	10.7MHz 2pole 15KHz bandwidth	5.00
MOTOROLA	4884863B01	11.7MHz 2pole 15KHz bandwidth	5.00
PTI	5350C	12MHz 2pole 15KHz bandwidth	5.00
PTI	5426C	21.4MHz 2pole 15KHz bandwidth	5.00
PTI	1479	10.7MHz 8pole bandwidth 7.5KHz at 3dB, 5KHz at 6dB	20.00
COMTECH	A10300	45MHz 2pole 15KHz bandwidth	6.00
FRC	ERXF-15700	20.6MHz 36KHz wide	10.00
FILTECH	2131	CF 7.825MHz	10.00

CERAMIC FILTERS

AXEL	4F449	12.6KC Bandpass Filter 3dB bandwidth 1.6KHz from 11.8-13.4KHz	10.00
CLEVITE	TO-01A	455KHz+-2KHz bandwidth 4-7% at 3dB	5.00
	TCF4-12D36A	455KHz+-1KHz bandwidth 6dB min 12KHz, 60dB max 36KHz	10.00
MURATA	BFB455B	455KHz	2.50
	BFB455L	455KHz	3.50
	CFM455E	455KHz +-5.5KHz at 3dB , +-8KHz at 6dB , +-16KHz at 50dB	6.65
	CFM455D	455KHz +-7KHz at 3dB , +-10KHz at 6dB , +-20KHz at 50dB	6.65
	CFR455E	455KHz +-5.5KHz at 3dB , +-8KHz at 6dB , +-16KHz at 60dB	8.00
	CFU455B	455KHz +-2KHz bandwidth +-15KHz at 6dB, +-30KHz at 40dB	2.90
	CFU455C	455KHz +-2KHz bandwidth +-12.5KHz at 6dB , +-24KHz at 40dB	2.90
	CFU455G	455KHz +-1KHz bandwidth +-4.5KHz at 6dB , +-10KHz at 40dB	2.90
	CFU455H	455KHz +-1KHz bandwidth +-3KHz at 6dB , +-9KHz at 40dB	2.90
	CFU455I	455KHz +-1KHz bandwidth +-2KHz at 6dB , +-6KHz at 40dB	2.90
	CFW455D	455KHz +-10KHz at 6dB , +-20KHz at 40dB	2.90
	CFW455H	455KHz +-3KHz at 6dB , +-9KHz at 40dB	2.90
	SFB455D	455KHz	2.50
	SFD455D	455KHz +-2KHz , 3dB bandwidth 4.5KHz +-1KHz	5.00
	SFE10.7MA	10.7MHz 280KHz +-50KHz at 3dB , 650KHz at 20dB	2.50
	SFE10.7MS	10,7MHz 230KHz +-50KHz at 3dB , 570KHz at 20dB	2.50
	SFG10.7MA	10.7MHz	10.00
NIPPON	LF-B4/CFU455I	455KHz +-1KHz	2.90
	LF-B6/CFU455H	455KHz +-1KHz	2.90
	LF-B8	455KHz	2.90
	LF-C18	455KHz	10.00
TOKIN	CF455A/BFU455K	455KHz +-2KHz	5.00
MATSUSHIRA	EFC-L455K	455KHz	7.00

SPECTRA PHYSICS INC. Model 088 HeNe LASER TUBES

POWER OUTPUT 1.6MW. BEAM DIA. .75MM BEAM DIR. 2.7MR 8KV STARTING VOLTAGE DC
68K OHM 1WATT BALLAST 1000VDC +-100VDC At 3.7MA $59.99

ROTRON MUFFIN FANS Model MARK4/MU2A1

115 VAC 14WATTS 50/60CPS IMPEDENCE PROTECTED-F 88CFM at 50CPS $ 7.99
105CFM at 60CPS

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RF TRANSISTORS

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
2N1561	$25.00	2N5920	$ 70.00	40608 RCA	$ 2.48	BFY90	$ 1.50
2N1562	25.00	2N5921	80.00	40673 RCA	2.50	BLW60C5	15.00
2N1692	25.00	2N5922	10.00	40894 RCA	1.00	BLX67	12.25
2N2857	1.55	2N5923	25.00	60247 RCA	25.00	BLX67C3	12.25
2N2857JAN	4.10	2N5941	23.00	61206 RCA	100.00	BLX93C3	22.21
2N2857JANTX	4.50	2N5942	40.00	62800A RCA	60.00	BLY87A	7.50
2N2876	13.50	2N5944	10.35	62803 RCA	100.00	BLY88C3	13.08
2N2947	18.35	2N5945	10.00	430414/3990RCA	50.00	BLY89C	13.00
2N2948	13.00	2N5946	12.00	3457159 RCA	20.00	BLY90	45.00
2N2949	15.50	2N5947	9.20	3729685-2 RCA	75.00	BLY92	13.30
2N3118	5.00	2N6080	6.00	3729701-2 RCA	50.00	BLY94C	45.00
2N3119	4.00	2N6081	7.00	3753883 RCA	50.00	BLY351	10.00
2N3134	1.15	2N6082	9.00	615467-902	25.00	BLY568C/CF	30.00
2N3287	4.90	2N6083	9.50	615467-903	40.00	C2M70-28R	92.70
2N3288	4.40	2N6084	12.00	2SC568	2.50	C25-28	57.00
2N3309	4.85	2N6094	11.00	2SC703	36.00	C4005	2.50
2N3375	17.10	2N6095	12.00	2SC756A	7.50	CD1659	20.00
2N3478	2.13	2N6096	16.10	2SC781	2.80	CD1899	20.00
2N3553	1.55	2N6097	20.70	2SC1018	1.00	CD1920	10.00
2N3553JAN	2.90	2N6105	21.00	2SC1042	24.00	CD2188	18.00
2N3632	15.50	2N6136	21.85	2SC1070	2.50	CD2545	24.00
2N3733	11.00	2N6166	40.24	2SC1216	2.50	CD2664A	16.00
2N3818	5.00	2N6267	142.00	2SC1239	2.50	CD3167	92.70
2N3866	1.30	2N6304	1.50	2SC1251	24.00	CD3353	95.00
2N3866JAN	2.20	2N6368	30.00	2SC1306	2.90	CD3435	26.30
2N3866JANTX	3.80	2N6439	55.31	2SC1307	5.50	CD3900	152.95
2N3866JANTXV	4.70	2N6459	18.00	2SC1424	2.80	CM25-12	20.00
2N3866AJANTXV	5.30	2N6567	10.06	2SC1600	5.00	CM40-12	27.90
2N3924	3.35	2N6603	13.50	2SC1678	2.00	CM40-28	56.90
2N3926	16.10	2N6604	13.50	2SC1729	32.40	CME50-12	30.00
2N3927	17.25	2N6679	44.00	2SC1760	1.50	CTC2001	42.00
2N3948	1.75	2N6680	80.00	2SC1909	4.00	CTC2005	55.00
2N3950	25.00	021-1	15.00	2SC1945	10.00	CTC3005	70.00
2N3959	3.85	01-80703T4	65.00	2SC1946	40.00	CTC3460	20.00
2N4012	11.00	35C05	15.00	2SC1947	10.00	DV2820S	25.00
2N4037	2.00	102-1	28.00	2SC1970	2.50	DXL1003P70	22.00
2N4041	14.00	103-1	28.00	2SC1974	4.00	DXL2001P70	19.00
2N4072	1.80	103-2	28.00	2SC2166	5.50	DXL2002P70	14.00
2N4080	4.53	104P1	18.00	2SC2237	32.00	DXL3501AP100F	47.00
2N4127	21.00	163P1	10.00	2SC2695	47.00	EFJ4015	12.00
2N4416	2.25	181-3	15.00	A2X1698	POR	EFJ4017	24.00
2N4427	1.25	210-2	10.00	A3-12	14.45	EFJ4021	24.00
2N4428	1.85	269-1	18.00	A50-12	24.00	EFJ4026	35.00
2N4430	11.80	281-1	15.00	A209	10.00	EN15745	20.00
2N4927	3.90	282-1	30.00	A283	6.00	FJ9540	16.00
2N4957	3.45	482	7.50	A283B	6.00	FSX52WF	58.00
2N4959	2.30	564-1	25.00	A1610	19.00	G65739	25.00
2N5016	18.40	698-3	15.00	AF102	2.50	G65386	25.00
2N5026	15.00	703-1	15.00	AFY12	2.50	GM0290A	2.50
2N5070	18.40	704	4.00	AR7115	20.00	HEP76	4.95
2N5090	13.80	709-2	11.00	AT41435-5	6.35	HEPS3002	11.40
2N5108	3.45	711	4.00	B2-8Z	10.70	HEPS3003	30.00
2N5109	1.70	733-2	15.00	B3-12	10.85	HEPS3005	10.00
2N5160	3.45	798-2	25.00	B12-12	15.70	HEPS3006	19.90
2N5177	21.62	3421	28.00	BAL0204125	152.95	HEPS3007	25.00
2N5179	1.04	3683P1	15.00	BF25-35	56.25	HEPS3010	11.34
2N5216	56.00	3992	25.00	B40-12	19.25	HF8003	10.00
2N5470	75.00	4164P1	15.00	B70-12	55.00	HFET2204	112.00
2N5583	3.45	4243P1	28.00	BF272A	2.50	HP35821	38.00
2N5589	9.77	4340P3	18.00	BFQ85	2.50	HP35826B	32.00
2N5590	10.92	4387P1	27.50	BFR21	2.50	HP35826E	32.00
2N5591	13.80	7104-1	28.00	BFR90	1.00	HP35831E	30.00
2N5596	99.00	7249-2	10.50	BFR91	1.65	HP35832E	50.00
2N5636	12.00	7283-1	37.50	BFR99	2.50	HP35833E	50.00
2N5637	15.50	7536-1	30.00	BFT12	2.50	HP35859E	75.00
2N5641	12.42	7794-1	10.50	BFW16A	2.50	HP35866E	44.00
2N5642	14.03	7795	15.00	BFW17	2.50	HXTR2101	44.00
2N5643	25.50	7795-1	15.00	BFW92	1.50	HXTR3101	7.00
2N5645	13.80	7796-1	24.00	BFX44	2.50	HXTR5101	31.00
2N5646	20.70	7797-1	36.00	BFX48	2.50	HXTR6104	68.00
2N5651	11.05	40081 RCA	5.00	BFX65	2.50	HXTR6105	31.00
2N5691	18.00	40279 RCA	10.00	BFX84	2.50	HXTR6106	33.00
2N5764	27.00	40280 RCA	4.62	BFX85	2.50	J310	1.00
2N5836	3.45	40281 RCA	10.00	BFX86	2.50	JO2000	10.00
2N5842	8.45	40282 RCA	20.00	BFX89	1.00	JO2001	25.00
2N5847	19.90	40290 RCA	2.80	BFY11	2.50	JO4045	24.00
2N5849	20.00	40292 RCA	13.05	BFY18	2.50	KD5522	25.00
2N5913	3.25	40294 RCA	2.50	BFY19	2.50	KJ5522	25.00
2N5916	36.00	40341 RCA	21.00	BFY39	2.50	M1106	13.75

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M1107	$16.75	MRF458	$20.70	NEO2160ER	$100.00	SD1009	$15.00
M1131	5.15	MRF464	25.30	NEO21350	5.30	SD1009-2	15.00
M1132	7.25	MRF466	18.97	NE13783	61.00	SD1012	10.00
M1134	13.40	MRF472	1.50	NE21889	43.00	SD1012-3	10.00
M9116	29.10	MRF475	3.10	NE57835	5.70	SD1012-5	10.00
M9579	6.00	MRF476	3.16	NE64360ER-A	100.00	SD1013	10.00
M9580	7.95	MRF477	20.00	NE64480 (B)	94.00	SD1013-3	10.00
M9587	7.00	MRF479	8.05	NE73436	2.50	SD1013-7	10.00
M9588	5.20	MRF492	23.00	NE77362ER	100.00	SD1016	15.00
M9622	5.95	MRF502	1.04	NE98260ER	100.00	SD1016-5	15.00
M9623	7.95	MRF503	6.00	PRT8637	25.00	SD1018-4	13.00
M9624	9.95	MRF504	7.00	PT3127A	5.00	SD1018-6	13.00
M9625	15.95	MRF509	5.00	PT3127B	5.00	SD1018-7	13.00
M9630	14.00	MRF511	10.69	PT3127C	20.00	SD1018-15	13.00
M9740	27.90	MRF515	2.00	PT3127D	20.00	SD1020-5	10.00
M9741	27.90	MRF517	2.00	PT3127E	20.00	SD1028	15.00
M9755	16.00	MRF525	3.45	PT3190	20.00	SD1030	12.00
M9780	5.50	MRF559	1.76	PT3194	20.00	SD1030-2	12.00
M9827	11.00	MRF587	11.00	PT3195	20.00	SD1040	5.00
M9848	35.00	MRF605	20.00	PT3537	7.80	SD1040-2	20.00
M9850	13.50	MRF618	25.00	PT4166E	20.00	SD1040-4	10.00
M9851	20.00	MRF626	12.00	PT4176D	25.00	SD1040-6	5.00
M9860	8.25	MRF628	8.65	PT4186B	5.00	SD1043	12.00
M9887	2.80	MRF629	3.45	PT4209	25.00	SD1043-1	10.00
M9908	6.95	MRF641	25.30	PT4209C/5645	25.00	SD1045	3.75
M9965	12.00	MRF644	27.60	PT4556	24.60	SD1049-1	2.00
MM1500	25.00	MRF646	29.90	PT4570	7.50	SD1053	4.00
MM1550	10.00	MRF648	33.35	PT4577	20.00	SD1057	10.00
MM1552	50.00	MRF816	15.00	PT4590	5.00	SD1065	4.75
MM1553	50.00	MRF823	20.00	PT4612	20.00	SD1068	15.00
MM1607	8.45	MRF846	44.85	PT4628	20.00	SD1074-2	18.00
MM1614	10.00	MRF892	35.50	PT4640	20.00	SD1074-4	28.00
MM1810	15.00	MRF894	46.00	PT4642	20.00	SD1074-5	28.00
MM1810	15.00	MRF901 3 Lead	1.00	PT5632	4.70	SD1076	18.50
MM1943	1.80	MRF901 4 Lead	2.00	PT5749	25.00	SD1077	4.00
MM2608	5.00	MRF902/2N6603JAN	15.00	PT6612	25.00	SD1077-4	4.00
MM3375A	17.10	MRF902B	18.40	PT6619	20.00	SD1077-6	4.00
MM4429	10.00	MRF904	2.30	PT6708	25.00	SD1078-6	24.00
MM8000	1.15	MRF905	2.55	PT6709	25.00	SD1080-7	7.50
MM8006	2.30	MRF911	2.50	PT6720	25.00	SD1080-8	6.00
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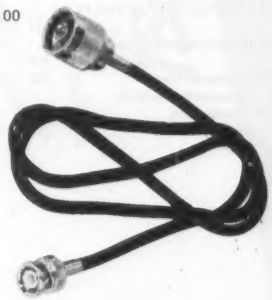

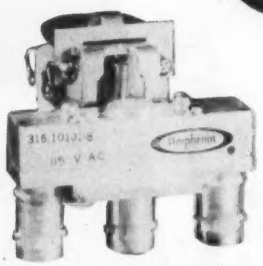

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- ☐ 1. Immediate purchase
- ☐ 2. Purchase within 6 months
- ☐ 3. Brand comparisons
- ☐ 4. Reference
- ☐ 5. Other

B. How many projects from 73 have you built within the last year?
- ☐ 1. None
- ☐ 2. 1–2
- ☐ 3. 3–4
- ☐ 4. 5 or more

C. What is your most useful source of information about the equipment you buy?
- ☐ 1. Magazine review
- ☐ 2. New product announcement
- ☐ 3. Manufacturer's brochure
- ☐ 4. Dealer's advertisement

D. Which of the following 73 features do you read regularly?
- ☐ 1. Never Say Die
- ☐ 2. 73 International
- ☐ 3. New Products
- ☐ 4. Review
- ☐ 5. RTTY Loop
- ☐ 6. Fun!
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- ☐ 10. QRX...
- ☐ 11. Satellites
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- ☐ 14. Letters

E. If you own a Commodore 64 or VIC 20 computer do you read any of the following magazines regularly?
- ☐ 1. RUN
- ☐ 2. Compute!'s Gazette
- ☐ 3. Compute!
- ☐ 4. Ahoy
- ☐ 5. Family Computing

F. If you own a TRS-80 computer, do you read any of the following magazines regularly?
- ☐ 1. 80 Micro
- ☐ 2. HOT CoCo
- ☐ 3. Rainbow

G. If you own an Apple computer, do you read any of the following magazines regularly?
- ☐ 1. inCider
- ☐ 2. A+
- ☐ 3. Nibble
- ☐ 4. Call A.P.P.L.E.

H. Do you:
- ☐ 1. Read 73 only
- ☐ 2. Read other amateur radio magazines as well

I. Which of the following microcomputers do you use in the hamshack?
- ☐ 1. Apple
- ☐ 2. VIC-20
- ☐ 3. Commodore 64
- ☐ 4. TRS-80 Color Computer
- ☐ 5. Other TRS-80 Models
- ☐ 6. Timex/Sinclair
- ☐ 7. CP/M-based

J. What type of information would you like to see in 73? (Pick 3)
- ☐ 1. Construction—gadgets
- ☐ 2. Construction—complex projects
- ☐ 3. Computer interfacing/RTTY
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- ☐ 6. Antennas
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51	56	61	66	71	176	181	186	191	196	301	306	311	316	321	426	431	436	441	446
52	57	62	67	72	177	182	187	192	197	302	307	312	317	322	427	432	437	442	447
53	58	63	68	73	178	183	188	193	198	303	308	313	318	323	428	433	438	443	448
54	59	64	69	74	179	184	189	194	199	304	309	314	319	324	429	434	439	444	449
55	60	65	70	75	180	185	190	195	200	305	310	315	320	325	430	435	440	445	450
76	81	86	91	96	201	206	211	216	221	326	331	336	341	346	451	456	461	466	471
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78	83	88	93	98	203	208	213	218	223	328	333	338	343	348	453	458	463	468	473
79	84	89	94	99	204	209	214	219	224	329	334	339	344	349	454	459	464	469	474
80	85	90	95	100	205	210	215	220	225	330	335	340	345	350	455	460	465	470	475
101	106	111	116	121	226	231	236	241	246	351	356	361	366	371	476	481	486	491	496
102	107	112	117	122	227	232	237	242	247	352	357	362	367	372	477	482	487	492	497
103	108	113	118	123	228	233	238	243	248	353	358	363	368	373	478	483	488	493	498
104	109	114	119	124	229	234	239	244	249	354	359	364	369	374	479	484	489	494	499
105	110	115	120	125	230	235	240	245	250	355	360	365	370	375	480	485	490	495	500

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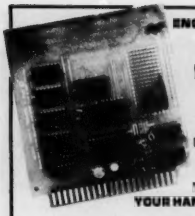

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- Anything you can do manually with your 16 digit keypad, the RAP-1 will do remotely using audio touch tones from any source.
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For more information contact your Kantronics dealer or write:
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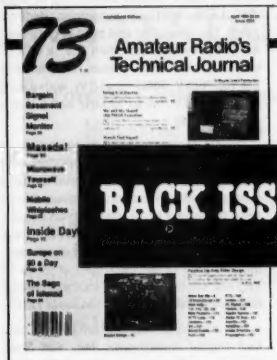
LAWRENCE, KS 66046



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✓ *See List of Advertisers on page 80*

NEW PRODUCTS

CUSHMAN CE-6488 ANALYZER

Cushman Electronics, Inc., has introduced the 6000-series model CE-6488, making the Spectrum 6000-series radio system analyzer family compatible with the IEEE-488 interface-bus standard (also know as GBIB, HP-IB, and IEC Bus).

This system analyzer offers the versatility of on-board microprocessor-based local control of the instrument for bench or site use, while also providing the ability to add a controller (and peripherals) on an IEEE-488 bus system for fully-automatic computer-controlled test routines.

By defining a computer as the controller of a CE-6488 radio system analyzer in an IEEE-488 test system, stored programs can evaluate a radio's performance and report back to you on either a display or hard-copy printout. In addition to acting as a quality gate to pass or reject a radio on the basis of the test results, the stored test programs allow operators with fewer radio skills to be effective and productive.

For additional information, contact *Cushman Electronics, 1525 Atteberry Lane, San Jose CA 95131; (408)-263-8100.* Reader Service number 477.

HEATH AUTOMATIC ANTENNA TUNER

Heath Company has expanded its amateur-radio line to include the new SA-2500 auto-tuno antenna tuner. The tuner features a continuously-variable roller inductor that can be preset for 18 different frequencies.

The SA-2500 permits the user to preset high and low frequencies on each of the nine bands from 160 to 10 meters. In the auto mode, the tuner will set the roller inductor to the preselected value and automatically adjust the preset for a proper match. A remote capability allows selected frequencies to be automatically tuned to the proper swr using only the transmitter's bandswitch, provided the transmitter is equipped for remote operation.

Manual tuning is made easy with three front-panel lever switches and dual wattmeters. The wattmeters read forward and reflected average power and swr in two ranges. An auto-range circuit automatically switches the wattmeters to the appropriate range.

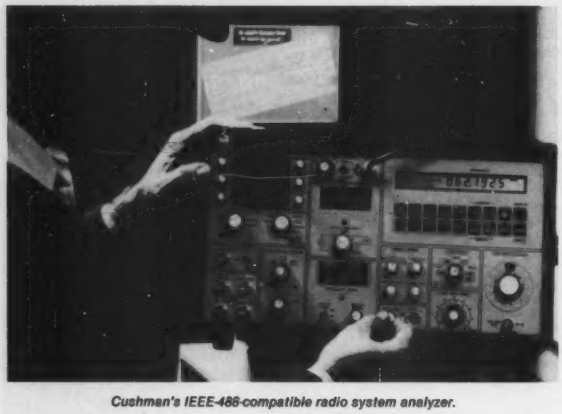
The SA-2500 effectively tunes and matches unbalanced feedlines and single-wire antennas at the full legal power limit. The SA-2500-1 4:1 balun accessory can be added for use with balanced ladder-line antennas. A front-panel coax switch allows the user to select three different antennas or to bypass the tuner.

The Heathkit SA-2500 automatic antenna tuner.

Heath's auto-tune antenna tuner installs directly into the transmission line to measure power on all frequencies between 1.8 and 30 MHz—200/2000 Watts in the forward direction and 50/500 Watts reflected. Swr readings on the reflected meter are from 1:1 to 3:1.

Front-panel indicators show when the roller inductor, transmitter, and antenna capacitors are being adjusted, the number of active roller inductor turns, high and low meter range, and when the tuned swr exceeds the selected ratio.

To receive more information on the SA-2500, write *Heath Company, Dept. 150-395, Benton Harbor MI 49022.* Reader Service number 478.



Cushman's IEEE-488-compatible radio system analyzer.

ACE VHF MONITOR

Ace Communications, Inc., has introduced a new VHF FM monitor receiver, model AR-33. The AR-33 is a microprocessor-controlled VHF FM featherweight portable receiver. It covers 140 to 170 MHz in 5-kHz steps. Frequencies are selected by thumbwheel switches, with a slide switch for 5-kHz increments. Features include two field-programmable memory channels, high sensitivity, an OSM coaxial antenna connector, and battery operation. The receiver is 130 mm × 63 mm × 26 mm; it weighs just under 200 grams.

For further information, contact *Ace Communications, Inc., 22511 Aspen Street, Lake Forest CA 92630; (714)-581-4900.* Reader Service number 480.

20-AMP OUTLET STRIP

The new Volector® series 9 20-Amp conditioned power strip features heavy-duty transient-voltage surge suppression. It meets IEEE Std. 587-1980 Category A and exceeds UL-1449 requirements.

It is rated for 2500 Watts continuous duty and is available with either four or six NEMA 5-20R receptacles. These receptacles will accept both 15- and 20-Amp plugs; therefore this power strip is ideal if your total current drain is slightly over 15 Amps. The strip features a six-foot-long heavy-duty line cord, a pilot light, an on/off switch, and a resettable circuit breaker.

For further information, contact *Pilgrim Electric Company, 105 Newtown Road, Plainview NY 11803; (516)-420-6990.* Reader Service number 479.

UHF FREQUENCY COUNTER

Digital Instruments, Inc. (formerly Davis Electronics), has announced their new model 7216 frequency counter. The new counter has a range of 10 Hz to 1.3 GHz and a gate time of 0.1 and 1.0 seconds at 100 MHz as well as .16 and 1.6 seconds at 1.3 GHz. The new Digital Instruments counter has a display consisting of eight .04" LEDs with an automatic decimal point. The prescaler and built-in gate light all fit neatly into the small 5½" × 6" × 2" all-metal blue case. Power requirements are 105–125 V, 50/60 Hz at 3 W, with a safe input of 120 V rms to 10 MHz and 2 V rms above 50 MHz.

Digital Instruments also produces an industrial-quality frequency counter with 1.3-GHz capability and additional features such as a proportional crystal oven, a time-base frequency of 10 MHz with an accuracy of plus or minus 5 ppm, short-term stability of plus or minus 1 ppm/hr after warm-up, and plus or minus 1 ppm at 10 to 50 degrees centigrade. The industrial-quality meter is cataloged as part number 7216A.

For additional information please contact *Digital Instruments, Inc., 636 Sheridan Drive, Tonawanda NY 14150; (716)-874-5848.* Reader Service number 476.

20-Amp conditioned power strip from Pilgrim Electric.

The new 1.3-GHz counter from Digital Instruments.

TS430S FILTERS

You can select 3 optional $80 Fox Tango filters for your TS430S: SSB Narrow (1.8 or 2.1KHz bandwidth), CW Narrow (250 or 400Hz), and AM (6.0KHz). To improve CW or AM reception, you must use one of the filters indicated. For SSB there is a *choice:* you can add one of the narrow filters, or you can use the Improved Filter Cascading Kit.

We recommend the Cascading Kit because it is more effective. It benefits *both* SSB and CW reception without affecting the other modes or TX. When you just add a narrow SSB filter, the mode switch lets you select *either* the stock (2.4KHz) filter *or* the narrow one. Either way, the I-F signal passes through only *one filter* — the other is idle! In the Fox Tango Cascading Kit *two filters are active*: the signal first passes through the stock filter and, near the end of the I-F chain, through a second filter — the high quality 8-pole Fox-Tango 2.1 KHz unit and its amplifier board. Here are the results:

	BEFORE (with Stock SSB)	AFTER (with Cascade Kit)
-30dB Bandwidth	3.2 KHz	2.16KHz
IMD Dynamic Range	83dB	100dB (50KHz Spacing)
Idle Noise (I-F)	0dB (Reference)	-8dB (below reference)

The narrower bandwidth improves selectivity. The greater dynamic range reduces QRM. The reduced noise makes weak-signal reception easier. And, as a bonus, the Shift control works much better. Installation is inboard, instructions are complete, no drilling is required, and only a few soldered connections are needed. However, skill is necessary; your dealer can help if desired.

INTRODUCTORY MONEY-SAVING SPECIALS

FTK-430S CASCADING KIT (including filter, board, instructions, etc.) ..... $85.
FTK-430S with one additional filter (CW or AM - reg. $60 ea.) $140
FTK-430S with two additional filters (CW and AM) ..... $185.

SPECIFY: Type desired and CW bandwidth if ordered.

SHIPPING: $3, Air $5, COD add $1, Overseas $10. FL Residence add 5% Tax. ✓304

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HAMSOFT/AMTOR - Includes all features of Hamsoft plus communication in all three modes of AMTOR. ■□◆◇

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For more information contact your Kantronics dealer, or write:
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✓ See List of Advertisers on page 80

CONTESTS

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

HUNTING LIONS IN THE AIR CONTEST
Starts: 1200 UTC January 12
Ends: 2400 UTC January 13

The contest is sponsored by Lions Clubs International and coordinated by Lions Club Rio de Janeiro Arpoador—Brazil. Participation is open to all duly licensed radio operators, Lion and non-Lion. There are two modes: phone and CW. Participation in both modes is allowed but points are counted separately. All amateur stations participating must operate within their licensing regulation. Separate categories will exist for single operators and radio clubs/societies. Multi-operators may participate as long as they do not operate simultaneously with the same prefix. However, each callsign used must be listed on the log.

Use all bands, 80, 40, 20, 15, and 10 meters. Associates of the Lions Club of Rio de Janeiro Arpoador will operate mainly within the first 50 kHz of each band and around 14,270, 21,270, and 28,270. Only one QSO with the same station on each band may be counted. Remember that phone and CW are counted separately!

EXCHANGE:

RS(T) and sequential QSO number. When contacts are made with Lions, Leos, or Lionesses, the name of the club contacted should be clearly identified.

SCORING:

QSOs within the same continent count 1 point while those between different continents count 3 points. Score 10 extra bonus points for each QSO with a member of a Lion, Lioness, or Leo Club from a different country or 5 points within the same country. Score 20 bonus points for a QSO with a member of the Lions Club Rio de Janeiro Arpoador. Contacts between Brazilian stations and members of the Arpoador club will count only 5 extra points. Contacts between members of the Arpoador club will not count any bonus points.

AWARDS:

For both categories, the Lions Club International will present trophies for first, second, and third place on both modes. For single operators, fourth through tenth places will receive plaques. In addition, each log sent by participants with a minimum of 15 contacts will receive a special certificate.

ENTRIES:

Keep a separate log for each mode. Each participant will note in the logs the callsign and information exchanged. Confirmation of contacts will be made by comparing the logs of the participants. Participants should send their logs by airmail not later than February 15th to Contest Committee, Rio de Janeiro Arpoador Lions Club, Rua Sao Francisco Xavier no. 246, Apt. 407, 22551—Rio de Janeiro-RJ-Brazil.

A5 WAS SSTV CONTEST
Starts: 1800 EST January 21
Ends: 1800 EST January 27

This is the 4th annual contest spon-

RESULTS

1984 BERMUDA CONTEST

	Bermuda		WK4F 2695
VP9IJ	2285625*		W3ARK 2205
VP9TAD	356160*		K5KSY 2065*
VP9LE	53820		WA2LWA 1975*
	Canada		W9RE 1950*
VE3BGX	121440*		W2FFQ 1925
VE3MFA	40500		W8DWP 1750
VE4ALO	3225*		W5EIJ 1665*
	UK		WA5IYX 1620*
G4CNY	376770*		WA2LUD 1420
G4UOF	141400*		W9YCV 1250
GW4BKG	42315*		W5UBW 1200*
GD4HOO	36040*		N8CQA 1170*
G4OSY	33150*		KD8PT 700*
G3UPS	16550*		N1ATS 625
G4OTU	13335*		W2IP 575*
G4FJT	12750*		KI1B 455*
G4MKT	7345*		W7RIR 200*
G4GFH	6375		WA1NCN 150
G4IJW	1330*		W9QWM 80*
G4BYA	855*		W2KTF 30
G4RVV	775*		W2CC 5
G3NT	660*		KB0YK 5*
G3YBH	510*		Federal Republic of Germany
G3NHF	465*		DF6PK 133110*
G4MTC	95*		DL6EAS 29500*
	USA		DK9IP 15565*
K1RM	274890*		DL8LAG 14755*
AD8P	232870*		DL3GAF 13040*
N1ZZ	58320*		DF5IM 9960*
N3RD	37810*		DF7DQ 3880*
KE1E	33465*		DF3IF 3850
K3DH	32200*		DL3SAW 3600*
W3MA	26100		DK5PE 3075*
W1DO	19080		DL7AHD 2865
KA1CNI	9850*		DL1BBO 1650*
W9UP	8745*		DK5DS 1590*
W6HX	8160*		DL7FBZ 1580*
K4PYD	4160		DF5TV 1540*
W4OWJ	4070*		DJ0EX 1475*
W3YFI	3000*		

* DENOTES AWARD WINNER

CALENDAR

JAN 1	ARRL Straight Key Night
JAN 5-6	ARRL QSO Party—CW
JAN 12	73 40-Meter World SSB Championship*
JAN 12-13	Hunting Lions In The Air Contest
JAN 13	73 75-Meter World SSB Championship*
JAN 19-20	73 160-Meter World SSB Championship*
JAN 19-20	ARRL QSO Party—Phone
JAN 21-27	A5 WAS SSTV Contest
JAN 26	73 15-Meter World SSB Championship*
JAN 26-27	West Virginia QSO Party
JAN 26-FEB 3	ARRL Novice Roundup
JAN 27	73 20-Meter World SSB Championship*
FEB 2-3	Vermont QSO Party
FEB 2-3	New Hampshire QSO Party
FEB 9-10	Dutch PACC Contest
FEB 16-17	ARRL DX Contest—CW
FEB 23	73 RTTY World Championship Contest
FEB 23-24	YL-ISSB Commo System QSO Party—Phone
MAR 2-3	ARRL DX Contest—Phone
MAR 16-17	YL-ISSB Commo System QSO Party—CW
MAR 16-17	Spring QRP CW Activity Weekend
MAR 16-17	Bermuda Amateur Radio Contest
MAR 30-31	Rio CW DX Party
APR 27-28	Helvetia Contest
JUN 8-9	Worldwide South America CW Contest
JUN 8-9	ARRL VHF QSO Party
JUN 22-23	ARRL Field Day

Note: Distant ARRL contest dates were still tentative at the time this list was compiled; check *QST* for any changes.

**73* contest rules published in the December issue of *73*. For entry forms or to submit an entry, send SASE(s) to the appropriate address(es) listed below:

40-Meter Contest: Dennis Younker NE6I, 43261 Sixth Street East, Lancaster CA 93535.
75-Meter Contest: Jose A. Castillo N4BAA, 1832 Highland Drive, Amelia Island FL 32034.
160-Meter Contest: Harry Arsenault K1PLR, 603 Powell Avenue, Erie PA 16505.
15-Meter Contest: Bill Gosney KE7C, 2665 N. Busby Rd., Oak Harbor WA 98277.
20-Meter Contest: Chuck Ingram WA6R, 44720 N. 11th Street East, Lancaster CA 93535.

Background Noise...

NEWSLETTER OF THE MONTH

It seems that every time I open up a newsletter, another editor is retiring. The latest is Rick Imbordino KS9V, Editor of *Background Noise*, journal of the Western Area FM Amateur Repeater Club (WAFAR). I've been reading this publication for the past several months, and I think that WAFAR will be very lucky to find someone as talented and dedicated as Rick.

Each issue of *Background Noise* is packed with information pertinent to the VHF/UHF scene, including operating news, regulatory proceedings, and equipment modifications. One of the cartoons which appeared in a recent edition is hanging on the wall here at *73*.

Rick, congratulations to you and the entire membership of WAFAR. And to all of our friends who regularly mail their newsletter to *73*, please accept our thanks and our wishes for a safe and happy New Year.

To enter your newsletter in *73*'s Newsletter of the Month Contest, send it to *73*, Pine Street, Peterborough NH 03458, Attn: Newsletter of the Month.

sored by *Amateur Television Magazine*. The object is to work as many different US states as possible on the video mode. All contacts must be in video form with a minimum of callsign and RSV signal reports sent and received. Count 10 points per SSTV QSO regardless of location, with 100 points awarded for each new state. Contacts with Alaska or Hawaii on SSTV count 500 points. The top scorer will receive a free 3-year subscription to *A5 ATV Magazine*, with 1-year subscriptions going to district leaders. All entrants will receive a special gold specialized-communications certificate suitable for framing. Logs must be sent to Contest Manager, *A5 ATV Magazine*, PO Box H, Lowden IA 52255. Indicate state and score on the front of the envelope. Logs and photos sent will be returned at the close of the contest-judging period. Results should be published in the March or April, 1985, issue of the magazine.

INTERNATIONAL RTTY ART COMPETITION

The Wireless Institute of Australia is running an International RTTY Art Competition as part of its 75th anniversary celebrations. Entries must not contain more than three overlinings and must be submitted with a hard-copy printout and Baudot tape.

Categories include: (a) best hand-generated original submitted by its author outside VK, (b) best hand-generated original submitted by its author who is a VK, and (c) best non-original hand-generated or computer-generated RTTY picture.

The completion closes August 31, 1985, and entries must be sent to: WIA 75 RTTY Art Competition, Wireless Institute of Australia, 412 Brunswick Street, Fitzroy 3065, Victoria, Australia.

RESULTS

1984 NEW JERSEY QSO PARTY

(Top scorers in boldface)

New Jersey Scores		
Bergen	**KA2OIW**	**3050**
	W2CC	234
	WA2ASQ	6
Burlington	**KX2W**	**32,912**
	W2XQ	**3500**
Camden	KA2QGO	836
Cape May	K4FFM	650
Cumberland	N2BNP	315
Essex	W2SUE	2150
	K2VX	253
	WA2ASQ	110
Mercer	WB2PKG	2678
	WB2KEL	171
Passaic	WA2ASQ	1026
Salem	**NC2V**	**3885**
	WB2KMR	893
Somerset	**KA2RLW+**	
(multi-op)	**KA2OEE**	**5181**
	WA2WJY	351
Sussex	**W2RQ**	**8234**

Out-of-State Scores		
Connecticut	**WA1NCN**	**185**
Maine	**N1PLI**	**312**
Eastern Pennsylvania	WA3JXW	4
Maryland/D.C.	KA3KBZ	16
S. Florida	WK4F	66
Kentucky	**WA4EBN**	**299**
New Mexico	N5EZA	4
Arizona	AK7J	16
Michigan	KA8IIN	84
Ohio	KA8MPT	6
West Virginia	W8VEN	40
Kansas	**N8CLV**	**180**

WEST VIRGINIA QSO PARTY
Starts: 1700 UTC January 26
Ends: 1700 UTC January 27

Sponsored by the West Virginia State AR Council, this contest is open to single operators only.

EXCHANGE:

RS(T), serial number, and state, country, or WV county.

FREQUENCIES:

Phone—10 kHz up from lower General band edges. CW—35 kHz up from low end. Novice—35 kHz up from lower band edge.

SCORING:

Count 1 point per QSO. WV stations multiply by total WV counties, states, and countries worked. Others multiply by total WV counties worked. Multiply score by 1.5 if running 200 Watts or less.

ENTRIES:

Mail logs by February 11th along with a large SASE for results, addressed to: K8BS, PO Box 1694, Charleston WV 25326.

FUN!

John Edwards KI2U
PO Box 73
Middle Village NY 11379

DIGITAL QUIZ

This is hard for me to say, but I have become a total, hopeless computer addict. Friends, I have a micro on my back.

It all started very innocently about four years ago. I was walking past my local Radio Shack Computer Center when I was struck by the sudden, uncontrollable urge to buy a TRS-80 Model III. Shaking slightly, with Mastercard in hand, I entered that den of wasted souls and purchased my first computer. The salesman, dressed in his natty three-piece suit, smiled; I whimpered. Oh, for those clean and wholesome days of amateur radio. Outdoors, with one foot on the peak of my roof and the other twisted in 600 feet of #12 copper wire.

At first, I thought I would only dabble with my new toy on weekends. But soon, those idle weekends grew into idle weeks, months, and years. Now, I'm a dissipated, slobbering mess. In addition to my original Model III I've expanded my addiction to include an IBM PC, Apple IIe, TRS-80 Model 100, Atari 400, and Commodore 64. Sigh. Groan.

Like all addicts, I had to find a way to feed my evil habit (computers aren't cheap), so I became a pusher. That's right, I turned to writing computer books and magazines, both to make money and to snare additional innocent victims. I've written for nearly all of the major computer magazines, most of which are mailed to subscribers in plain brown wrappers. Heaven help me, I even write a computer column in a magazine aimed at doctors. Now, as I find myself hitting silicon bottom, I turn my attention to my favorite fraternity—radio amateurs. The result is this month's column.

Please forgive me. I'm a sick man.

ELEMENT 1
MULTIPLE CHOICE

1) A repeater that carries computer data is often called a:
   1) digipeater
   2) compupeater
   3) datapeater
   4) waste of time
2) The first popular microprocessor was:
   1) Motorola's MC6502
   2) Intel's 4004
   3) Zilog's Z-80A
   4) Kenwood's YE-1
3) Which one of the following computer languages was named after Lord Byron's daughter:
   1) Pascal
   2) Susan
   3) Ada
   4) Lady
4) The first computer, ENIAC, weighed:
   1) 30 pounds
   2) 300 pounds
   3) 3 tons
   4) 30 tons
5) Which one of the following companies never manufactured computers:
   1) General Electric
   2) RCA
   3) Toyota
   4) Singer

ELEMENT 2
TRUE-FALSE

	True	False
1) Control Data Corp. is based in New York City.	____	____
2) A popular telephone modem speed is 300 bytes per second.	____	____
3) Superconductor devices usually operate at room temperature.	____	____
4) LED displays require reflected light to view.	____	____
5) An RS-232C interface is a parallel port.	____	____
6) AMTOR is a computer language.	____	____
7) Each dot on a computer display is called a "pixie."	____	____
8) Most people also call a RAM device a "computer on a chip."	____	____
9) To start Apple Computer, Wozniak and Jobs sold an old VW beetle.	____	____
10) Model 32 Teletypes were once commonly used as computer terminals	____	____

ELEMENT 3
FILL IN THE BLANK

1) Before vacuum tubes and semiconductors, computers used ___ as logic switches.
2) ___ Univac
3) The transistor: Shockley, Brattain, and ___.
4) ___ is a program that can imitate a psychiatric interviewer.
5) The IBM PC primary microprocessor is an ___.

ELEMENT 4
MATCHING

Match the computer pioneer on the left with his achievement on the right.

1) Alan Turing	A) Data processing punch cards
2) Adam Osborne	B) Founded IBM
3) Thomas J. Watson, Sr.	C) Analytical engine
4) Herman Hollerith	D) First successful portable computer
5) Samuel Morse	E) Silicon chip
6) Charles Babbage	F) Automatic computing engine
7) Howard Aiken	G) Binary electrical code
8) Gary Kildall	H) CP/M
	I) Mark 1

THE ANSWERS

Element 1:

1—1 And they're becoming very popular.
2—2 Designed by Marcian "Ted" Hoff in 1969.
3—2 After Ada Lovelace.
4—4 It also had a power dissipation of 150,000 Watts.
5—3 Not yet anyway.

Element 2:

1—False	Minneapolis MN.
2—False	That's 300 *bits* per second.
3—False	Most operate at temperatures near absolute zero.
4—False	You're confusing LEDs with LCDs.
5—False	A serial port.
6—False	It's a RTTY format.
7—False	Pixel.
8—False	Only if they're not too smart. A random-access-memory unit contains no processing abilities.
9—False	It was a VW bus.
10—False	As five-level units, Model 32s were basically used for telecommunications purposes (including amateur RTTY).

Element 3:

1—Relays
2—Sperry
3—Bardeen
4—Eliza
5—Intel 8088

Element 4:

1—F, 2—D, 3—B, 4—A, 5—G, 6—C, 7—I, 8—H.

SCORING

Element 1:
Five points for each correct answer.
Element 2:
Two and one-half points for each correct answer.
Element 3:
Five points for each correct answer.
Element 4:
Four points for each correct match.

How did you do?
1-20 points—You're clean
21-40 points—A dabbler
41-60 points—On the road
61-80 points—Computer junkie
81-100+ points—In the gutter

NEW FROM MFJ

MFJ'S MOST ADVANCED RTTY/ASCII/AMTOR/CW COMPUTER INTERFACE HAS FM, AM MODES, LED "SCOPE" TUNING ARRAY, RS-232 INTERFACE, VARIABLE SHIFT TUNING, 170/850 Hz TRANSMIT, TRUE MARK-SPACE DETECTION.

MFJ-1229
$179.95

FREE MFJ RTTY/ASCII/CW software for C-64/VIC-20. **Complete package includes MFJ-1229, software on tape, cables for C-64/VIC-20.**

Engineering, performance, value and features sets MFJ's most advanced RTTY/ASCII/AMTOR/CW computer interface apart from others.

FM (limiting) mode gives easy, trouble-free operation. Best for general use, off-shift copy, drifting signals, and moderate signal and QRM levels.

AM (non-limiting) mode gives superior performance under weak signal conditions or when there are strong nearby stations.

Crosshair mark-space LED tuning array simulates scope ellipse for easy, accurate tuning even under poor signal-to-noise conditions. Mark and space outputs for true scope tuning.

Transmits on both 170 Hz and 850 Hz shift.

Built-in RS-232 interface, no extra cost.

Variable shift tuning lets you copy any shift between 100 and 1000 Hz and any speed (5-100 WPM RTTY/CW and up to 300 baud ASCII). Push button for 170 Hz shift.

Sharp multi-pole mark and space filters give true mark-space detection. Ganged pots give space passband tuning with constant bandwidth. Factory adjusted trim pots for optimum filter performance.

Multi-pole active filters are used for pre-limiter, mark, space and post detection filtering. Has automatic threshold correction. This advanced design gives good copy under QRM, weak signals and selective fading.

Has front panel sensitivity control.

Normal/Reverse switch eliminates retuning while checking for inverted RTTY. Speaker jack. +250 VDC loop output.

Exar 2206 sine wave generator gives phase continuous AFSK tones. Standard 2125 Hz mark and 2295/2975 Hz space. Microphone lines: AFSK out, AFSK ground, PTT out and PTT ground.

FSK keying for transceivers with FSK input.

Has sharp 800 Hz CW filter, plus and minus CW keying and external CW key jack.

Kantronics software compatible socket.

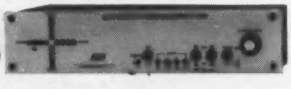
Exclusive TTL/RS-232 general purpose socket allows interfacing to nearly any personal computer with most appropriate software. Available TTL/RS-232 lines: RTTY demod out, CW demod out (TTL only), CW-ID in, RTTY in, PTT in, key in. All signal lines are buffered and can be inverted using an internal DIP switch.

Metal cabinet. Brushed aluminum front. 12½x2½x6 inches. 18 VDC or 110 VAC with optional AC adapter, MFJ-1312, $9.95.

Plugs between rig and C-64, VIC-20, Apple, TRS-80C, Atari, TI-99 and other personal computers. Use MFJ, Kantronics, AEA and other RTTY/ASCII/AMTOR/CW software.

7-IN-1 RTTY OPERATING AID

MFJ-1221
$79.95



Indispensable. Improves any RTTY station.

1. **Crosshair LED "scope" Tuning Array.** Makes tuning quick and easy with dead-on accuracy. Tune for maximum vertical and horizontal display.
2. **Scope Adapter.** Mark/Space outputs for scope.
3. **Shift Indicator.** LEDs indicate 170, 425, 850 Hz shift. Especially useful for RTTY outside ham bands.
4. **Sharp Mark and Space Filters.** Greatly improves copy under crowded, fading and weak signal conditions. For 170, 425, 850 Hz shifts.
5. **Normal-Reverse Switch.** Check for inverted RTTY without changing sidebands and retuning.
6. **Output Level Control.** Adjust signal level into TU.
7. **Limiter.** Evens out signal variation for easier, smoother copy.

Plugs between receiver and TU. Mark is 2125 Hz and Space is 2295, 2550, or 2975 Hz. 10x2x6 inches. Uses floating 18 VDC or 110 VAC with AC adapter, MFJ-1312, $9.95.

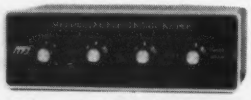
24/12 HOUR CLOCK/ID TIMER

MFJ-106 **$19.95**

Switch to 24 hour UTC or 12 hour format! Battery backup. ID timer alerts every 9 minutes after reset. Red .6 in. LEDs. Synchronizable to WWV. Alarm, Snooze function. Minute, hour set switches. PM, alarm on indicators. Gray/Black cabinet. 5x2x3 in. 110 VAC, 60 Hz.

MFJ ELECTRONIC KEYER

MFJ-407
$69.95



MFJ-407 Deluxe Electronic Keyer sends iambic, automatic, semi-auto or manual. Use squeeze, single lever or straight key. Plus/minus keying. 8 to 50 WPM. Speed, weight, tone, volume controls. On/Off, Tune, Semi-auto switches. Speaker. RF proof. 7x2x6 inches. Uses 9 V battery, 6-9 VDC or 110 VAC with AC adapter, MFJ-1305, $9.95.

MFJ PORTABLE ANTENNA

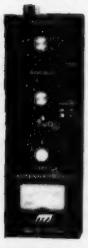
MFJ's Portable Antenna lets you operate 40, 30, 20, 15, 10 meters from apartments, motels, camp sites, vacation spots, nearly any electrically clear location where space for a full size antenna is a problem.

A telescoping whip (extends to 54 in.) is mounted on self-standing 6x3x6 inch aluminum case. Built-in antenna tuner, field strenght meter, 50 feet RG-58 coax. Complete multi-band portable antenna system that you can use nearly anywhere. Up to 300 watts PEP.

MFJ-1621
$79.95

MFJ ANTENNA BRIDGE

MFJ-204
$79.95



MFJ Antenna Bridge. Trim your antenna for optimum performance quickly and easily. Read antenna resistance up to 500 ohms. Covers all hams bands below 30 MHz. Measure resonant frequency of antenna. Tells to lenghten or shorten antenna. Easy to use, connect antenna, set frequency, adjust bridge for meter null and read antenna resistance. Has frequency counter jack. Use as signal generator. Portable, self contained. 4x2x2 in. 9 V battery or 110 VAC with adapter, MFJ-1312, $9.95.

MICROPHONE EQUALIZER

MFJ-550
$49.95

Greatly improves transmitted SSB speech for maximum talk power. Evens out speech peaks and valleys due to voice, microphone and room characteristics that makes speech hard to understand. Produces cleaner, more intelligible speech on receiving end. Greatly improves mobile operation by reducing bassy peaks due to acoustic resonances. Plugs between mic and rig. 4 pin mic jack, shielded output cable. High, mid, low controls provide ±12 db boost or cut at 490, 1170, 2800 Hz. Mic gain, on/off/bypass switch. "On" LED. 7x2x6 inches. 9 V battery, 12 VDC or 110 VAC with adapter, MFJ-1312, $9.95.

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- One year **unconditional** guarantee • Made in USA.
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VISA® MasterCard

MFJ ACCESSORIES

300 WATT ANTENNA TUNER HAS SWR/WATTMETER, ANTENNA SWITCH, BALUN. MATCHES VIRTUALLY EVERYTHING FROM 1.8 TO 30 MHz.

$99.95 MFJ-941D

NEW FEATURES

MFJ's fastest selling tuner packs in plenty of new features!
- **New Styling!** Brushed aluminum front. All metal cabinet.
- **New SWR/Wattmeter!** More accurate. Switch selectable 300/30 watt ranges. Read forward/reflected power.
- **New Antenna Switch!** Front panel mounted. Select 2 coax lines, direct or through tuner, random wire/balanced line or tuner bypass for dummy load.
- **New airwound inductor!** Larger more efficient 12 position air-wound inductor gives lower losses and more watts out. Run up to 300 watts RF power output. Matches everything from 1.8 to 30 MHz: dipoles, inverted vee, random wires, verticals, mobile whips, beams, balanced and coax lines. Built-in 4:1 balun for balanced lines. 1000V capacitor spacing. Black. 11x3x7 inches. Works with all solid state or tube rigs. Easy to use, anywhere.

RTTY/ASCII/CW COMPUTER INTERFACE

MFJ-1224 $99.95

Free MFJ RTTY/ASCII/CW software on tape and cable for VIC-20 or C-64. Send and receive computerized RTTY/ASCII/CW with nearly any personal computer (VIC-20, Apple, TRS-80C, Atari, TI-99, Commodore 64, etc.). Use Kantronics or most other RTTY/CW software. Copies both mark and space, any shift (including 170, 425, 850 Hz) and any speed (5-100 WPM RTTY/CW, 300 baud ASCII). Sharp 8 pole active filter for CW and 170 Hz shift. Sends 170, 850 Hz shift. Normal/reverse switch eliminates retuning. Automatic noise limiter. Kantronics compatible socket plus exclusive general purpose socket. 8x1¼x6 in. 12-15 VDC or 110 VAC with adapter, MFJ-1312, $9.95.

RX NOISE BRIDGE

Maximize your antenna performance! **$59.95** MFJ-202B

Tells whether to shorten or lengthen antenna for minimum SWR. Measure resonant frequency, radiation resistance and reactance.

New Features: individually calibrated resistance scale, expanded capacitance range (±150 pf). Built-in range extender for measurements beyond scale readings. 1-100 MHz. Comprehensive manual. Use 9 V battery. 2x4x4 in.

INDOOR TUNED ACTIVE ANTENNA

NEW! IMPROVED! with higher gain **"World Grabber" rivals or exceeds reception of outside long wires!** Unique **tuned** Active Antenna minimizes intermode, improves selectivity, reduces noise outside tuned band, even functions as preselector with external antennas. Covers 0.3-30 MHz. Tele scoping antenna. Tune, Band, Gain, On-off bypass controls. 6x2x6 in. Uses 9V battery, 9-18 VDC or 110 VAC with adapter, MFJ-1312, $9.95. **MFJ-1020A $79.95**

POLICE/FIRE/WEATHER 2 M HANDHELD CONVERTER

Turn your synthesized scanning 2 meter handheld into a hot Police/Fire/Weather band scanner! **$39.95** MFJ-313

144-148 MHz handhelds receive Police/Fire on 154-158 MHz with direct frequency readout. Hear NOAA maritime coastal plus more on 160-164 MHz. Converter mounts between handheld and rubber ducky. Feedthru allows simultaneous scanning of both 2 meters and Police/Fire bands. No missed calls. Crystal controlled. Bypass/Off switch allows transmitting (up to 5 watts). Use AAA battery. 2¼x1½x1½ in. BNC connectors.

MFJ/BENCHER KEYER COMBO

MFJ-422 $109.95

The best of all CW worlds- a deluxe MFJ Keyer in a compact configuration that fits right on the Bencher iambic paddle! MFJ Keyer - small in size, big in features. Curtis 8044-B IC, adjustable weight and tone, front panel volume and speed controls (8-50 WPM). Built-in dot-dash memories. Speaker, sidetone, and push button selection of semi-automatic/tune or automatic modes. Solid state keying. Bencher paddle is fully adjustable; heavy steel base with non-skid feet. Uses 9 V battery or 110 VAC with optional adapter, MFJ-1305, $9.95.

VHF SWR/WATTMETER

MFJ-812 $29.95

Low cost VHF SWR/Wattmeter! Read SWR (14 to 170 MHz) and forward/reflected power at 2 meters. Has 30 and 300 watts scales. Also read relative field strength. 4x2x3 in.

1 KW DUMMY LOAD

MFJ-250 $39.95

Tune up fast, extend life of finals, reduce QRM! Rated 1KW CW or 2KW PEP for 10 minutes. Half rating for 20 minutes, continuous at 200 W CW, 400 W PEP. VSWR under 1.2 to 30 MHz, 1.5 to 300 MHz. Oil contains no PCB. 50 ohm non-inductive resistor. Safety vent. Carrying handle. 7½x6¾ in.

24/12 HOUR CLOCK/ID TIMER

MFJ-106 $19.95 *NEW*

Switch to 24 hour UTC or 12 hour format! Battery backup maintains time during power outage. ID timer alerts every 9 minutes after reset. Red LED .6 inch digits. Synchronizable with WWV. Alarm with snooze function. Minute set, hour set switches. Time set switch prevents mis-setting. Power out, alarm on indicators. Gray and black cabinet. 5x2x 3 inches. 110 VAC, 60 Hz.

DUAL TUNABLE SSB/CW/RTTY FILTER

MFJ-752B $99.95

Dual filters give unmatched performance! The primary filter lets you peak, notch, low pass or high pass with extra steep skirts. Auxiliary filter gives 70 db notch, 40 Hz peak. Both filters tune from 300 to 3000 Hz with variable bandwidth from 40 Hz to nearly flat. Constant output as bandwidth is varied; linear frequency control. Switchable noise limiter for impulse noise. Simulated stereo sound for CW lets ears and mind reject QRM. Inputs for 2 rigs. Plugs into phone jack. Two watts for speaker. Off bypasses filter. 9-18 VDC or 110 VAC with optional adapter, MFJ-1312, $9.95.

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73 INTERNATIONAL

Each month, 73 brings you ham-radio news from around the world. In this collection of reports from our foreign correspondents, we present the latest news in DX, contests, and events, as well as keep you abreast of the technical achievements of hams in other countries.

If you would like to contribute to your country's column, write to your country's correspondent or to 73 Amateur Radio's Technical Journal, *Pine Street, Peterborough NH 03458, USA, Attn: Perry Donham* ∧W1O.

AUSTRALIA

J. E. Joyce VK3YJ
44 Wren Street
Altona 3018
Victoria
Australia

OUR 75TH ANNIVERSARY

1985 will be a very interesting year for both VK and overseas amateurs as some of the special events planned to celebrate the WIA's 75th year as a national amateur-radio body look to be great fun for all those concerned. Every division or state in Australia is trying to do something significant towards celebrating this most special event. For example, the VK3 division has a RTTY art contest planned, among other things, with prizes for original RTTY pictures and further prizes for reproductions of classic paintings. This contest is open to all WIA members.

There has been a great upsurge in RTTY in VK3 of late, due mainly to what appears to be an unlimited supply of used Siemens 100 teleprinter machines, most of which are complete right down to the supply of paper. These machines are being sold at a very low cost—the average price being around A$50.00. As most of these machines have been checked and serviced by a volunteer group of local amateurs called "The RTTY Fixers Group," it represents an easy way for local amateurs to get involved in this aspect of amateur radio.

THE RTTY FIXERS GROUP

This is a band of dedicated RTTY operators led by Fred McConnell VK3BOU. They have spent countless hours servicing these machines and adjusting them to 45.45 baud. This group also conducts RTTY workshops at the VK3 WIA club rooms to help the newcomer learn the finer points of maintenance on these fine teleprinters.

Several of these machines have been sent to other divisions, so we can expect an upsurge of RTTY from all VK in the very near future.

Band	Segment	Calling Frequency
160m	1825-1835	1825
80m	3620-3640	3630
40m	7040-7060	7050
30m	10140-10150	10140
20m	14070-14110	14090
17m	18100-18110	18100
15m	21075-21125	21090
13m	24920-24930	24920
10m	28050-28150	28090
6m	52080-52100	52080

Fig. 1.

Places to Look

Queensland (VK4) has a RTTY broadcast on 7.035 MHz at 1000 UTC from the Southeast teletype group, with their weekly news bulletin each Monday night.

The frequency segments and calling frequencies in Fig. 1 are recommended for use on the various amateur bands Australia-wide.

In 1983, Bill VK8ZWM, with other RTTY enthusiasts, formed a group called "The Territory Amateur Radio Teleprinter Society." They transmit a weekly broadcast on 3.555 at 0915 UTC each Sunday. This broadcast is transmitted by Mr. H. Anderson VK8HA, the Darwin Radio Club's president.

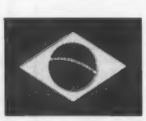
VK9Z—WILLIS ISLAND

Willis Island is active again with Andy VK9ZA, who is on his third trip there, taking over from Graham VK9ZW at the end of June. Andy is operational on most bands, including six meters. As usual, all QSLs for Willis Island operations go to Jill VK6YL, either direct or via the bureau.

QSL PROBLEMS IN VK2

Headlining the uncollected QSL problem (this time in VK2), in line with an earlier Divisional Council decision, the QSL manager of VK2 placed the following in the Public Notices section of the *Sydney Morning Herald* on Saturday, June 16, 1984!

> W.I.A. (N.S.W. Division) Q.S.L. Bureau, as from the 31st July, 1984, and regularly thereafter, all cards held at the bureau, whether for members or non-members, and unclaimed for two years, will be destroyed without further notice being given.
>
> *Signed:* **D. Pearson (Manager)**
> **Box 73**
> **Teralba 2284, N.S.W.**



BRAZIL

Gerson Rissin PY1APS
PO Box 12178 Copacabana
20000 Rio de Janeiro, RJ
Brazil

THE FIRST CWRL AWARD

The state of Rio de Janeiro is known around the world for the beautiful beaches it has along its coast. Among them, Copacabana, Ipanema, and Leblon, located in the city of Rio de Janeiro, are the main ones. Many cities in the state of Rio de Janeiro have their own beaches, and especially in the region called Big Lakes, we can find paradisiacal spots such as the beaches of Marica, Saquarema, Cabo Frio, and Araruama.

The amateurs of that region, headed by a group located in Araruama, established a CW group called Grupo de CW da Regiao dos Lagos, which means CW group of the Lakes Region. The group sponsors the CWRL Award, which never has been requested by any foreign station. The award is very beautiful—and the secretary, Ayiton T. Campos PY1AZG, is anxious to issue the first certificate for an amateur outside Brazil. The CWRL Award is available to all licensed amateurs for confirmed contacts with: (A) 29 Brazilian stations whose first *suffix* letters form the phrase "Araruama—onde o sol passa o inverno" (which means: Araruama—where the sun spends the winter), and (B) three CWRL members (any prefix or suffix).

Contacts must have been made after January 1, 1983, on any amateur band. Only two-way CW contacts are allowed. Send GCR log of stations worked (call, date, time, band, and report) and 10 IRCs for mailing expenses to: CWRL Bureau, PO Box 91, 28970 Araruama, RJ, Brazil. There are no special endorsements for the CWRL Award.

SWL: Same rules.

CWRL members are PY1s AFA, APS, ASI, AZG, BVY, CC, COA, DPG, DEA, DFF, DGB, DJY, DMX, DQV, DWH, DWM, EBK, ECL, ER, EWN, GO, MIZ, PA, PL, QN, QP, RD, RW, TBW, TG, TQ, TQZ, TZ, UZ, VEH, VMV, WXU, and YT.

Most of them are very active and 100% QSL. A few members changed their call-sign suffixes of 3 letters to two letters. So, if you have any QSL of a station not mentioned above but clearly written on the QSL card, "CWRL Member," it will be good for credit.

CYPRUS

Aris Kaponides 5B4JE
PO Box 1723
Limassol
Cyprus

Summertime in Cyprus, as in every country, is holiday time. So most amateurs go on holiday either abroad or in their own country. For this reason, amateur activity was restricted and not many 5B4s were on the HF bands. However, many 5B4s were hamming, on the move enjoying their recently-approved mobile licenses or from their holiday QTHs. The fine temperate climate of Cyprus during the summer gives a chance for all from the amateur fraternity to get together outdoors on picnics and other outings.

The Nicosia group had two social occasions, a dance and dinner in Nicosia and a barbecue under the Cyprus pines on Troodos mountain, where every ham showed his ability and capacity in eating and drinking. Hi!

The Limassol group also organized an excellent get-together in the wonderful surroundings of Pissouri Beach, where the blue sea, the beautiful women, the idyllic scenery, the tasty food, and especially the friendliness of all the hams and members of their families made this a 100% success. Besides the Limassol group, on this occasion were also members of the Paphos group such as Sotos 5B4JX with his XYL, Maria 5B4JZ and daughter YL, Flora 5B4PO, and other friends and guests of the group.

The Limassol group also organized a second social event by having dinner and then going midnight swimming in Limassol Bay, which was also very successful.

Radio activity by Cyprus amateurs is hoped to increase during the autumn and wintertime. Quite a few HF beams have been bought, with 3 or 4 elements, and lots of young people got their licenses recently, so (I am sure) the 5B4 callsign is going to be heard regularly on the bands. Some 5B4 stations, such as those of 5B4IT, 5B4MD, 5B4MC, and 5B4NG are equipped with RTTY facilities, and very soon 5B4CV will be active with SSTV with his home-brew equipment.

Generally, during the summertime, the activity was mostly on VHF and 20m, with the occasional DXing of 5B4JE on 40m and 80m. During the winter I hope to operate more on 40m, 80m, and 160m, so readers may look for me around 7.045 MHz, 7.083 MHz, 3.795 MHz, and 1.835 MHz, or 1.850 MHz usually between 2100 and 2200 UTC.

CZECHOSLOVAKIA

Rudolf Karaba (OK3KFO ARC)
Komenskeho 1477/8
955 01 Topolcany
Czechoslovakia

CRC, PO Box 68, 113 27 Praha 1, Czechoslovakia, is giving these awards for non-European countries:

100-OK—This diploma is awarded for contacts with various OK/OL stations. The contacts are valid if since January 1, 1954. Endorsements are given for 200, 300, 400, 500, and 1000 stations. 5 IRCs and the application should be sent to CRC.

OK-SSB—This can be gained for contacts with OK stations if the number of 25 points is reached, irrespective of the date. For contacts in the bands of 28, 21, and 14 MHz there is one point. For contacts in the bands of 7, 3.5, and 1.8 MHz there are two points. 5 IRCs and the application should be sent to CRC.

Be careful! The following general conditions are valid for all the diplomas awarded in Czechoslovakia: In case the contacts are made in the *OK-DX Contest* (annually the second Sunday in November), it is not necessary to present QSL cards. Send only the application together with a log from the contest to CRC.

RTTY

In Brno (the capital of Moravia), two further radio clubs, OK2KBR and OK2KFR, have been put into operation on RTTY. They use teletypewriters RFT T-51 and our T-100; converters have been operating together with active filters. OK2BFS had tested the Intel 85 microprocessor system and found out that a high-frequency field from the transmitter, 250 Watts, does not matter. It cannot be said, however, about ZX-81, where 30 Watts was obstructive.

AMSAT-OSCAR 10

The number of DXCC countries which have appeared when operating AO-10/B has increased to 102 (for the last time thanks to the DXpedition to San Marino—T77A, T77C, T77U).

Excessive trespassing of recommended erp has been continuing further on. For these reasons, for example, here in Czechoslovakia RSGB bulletins broadcast by GB2RS on AO-10/B with a prescribed erp cannot be understood. Therefore, "crocodiles" usually roar with the intensity of S8!

At present, 4 stations have been working actively in the region of East Slovakia: Ondrej OK3AU from Kosice, Stano OK3ZFA from Poprad, Viktor OK3LW from

Michalovce, and Fero OK3FH from Presov. OK3AU heard, by means of AO-10/B, another station from New Zealand. It was ZL1TFI. Unfortunately he did not establish any contacts this time either.

GREAT BRITAIN

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England

THE UK SCENE

The major news on the UK amateur scene at the time of writing is the issue by the Department of Trade and Industry (the UK regulatory body) of the new amateur license schedule. The schedule takes the form of an annex to the main license and defines the detailed technical constraints within which the licensee's station must be operated.

I have written before of the love of bureaucracy in the UK establishment, particularly those parts involved in the issue, control, and regulation of licenses related to radio broadcasting in any shape or form. Those of you who thought that a revised 1984 license schedule might be couched in plain English can return to your drawing boards. Lovers of legalistic jargon can rest easy!

I won't bore you with extensive quotations from the complete schedule (reproducing it fully would take up all my column space), but you may be interested to know of some of the restrictions placed on UK amateurs.

Perhaps the main change (certainly in terms of the number of words) is the adoption of the revised symbols for classes of emission as defined by the International Telecommunications Union (ITU) in Geneva in 1982. Now we have to write J3E in the log when using single-sideband transmissions, or F3C for some types of facsimile transmission. The schedule adds to the confusion by listing the permitted types of transmission by frequency band in simple terms (such as Morse, telephony, RTTY, and so on).

This same chart lists the "status of allocation" for each band; in other words, it defines the basis under which each particular band is available for use by amateurs. These range from simple definitions such as "Primary" and "Secondary" to "Secondary, Users must accept interference from the ISM allocation in this band," and "Secondary, This band is not available for use within the area bounded by 53N 0ZE, 55N 0ZE, 53N 03W, and 55N 03W."

UK amateurs need to be good at geography as well as everything else!

Antenna buffs may also like to know that the schedule explains that erp (effective radiated power) is used below 1 GHz and eirp (effective isotropically radiated power) above 1 GHz. It adds (helpfully?) that eirp is 2.1 dB greater than erp.

I don't know whether or not it's coincidence, but within days of publication of the new schedule, the DTI agreed to supply the RSGB with statistics relating to successful prosecutions under the new Telecommunications Act.

NASA astronaut Tony England W8ORE visited RSGB HQ recently and outlined his plans to repeat W5LFL's earlier shuttle mission. I do hope he has thought of a new way to institute and conduct QSOs. I wrote previously of the debacle on 2m when a million lids tried simultaneously to cause chaos (and largely succeeded, I might add).

The RSGB has just published an up-to-date list of QSL bureau sub-managers, which prompts me to reflect on the effort put in by this dedicated bunch. The RSGB QSL bureau is free to all RSGB members. Outgoing cards are sent to a single point for distribution to overseas bureaux. Incoming cards, though, are handled by no less than 58 sub-managers, each of whom deals with a particular range of calls. For example, my incoming cards, as for all cards in the range G4EAA to G4EZZ, are handled by G8OPA. The volume of mail such work must generate, to say nothing of the need for storage and sorting space, requires a certain dedication not found easily. I can well imagine some of the bureau sub-managers spending more time sorting QSL calls than conducting QSOs.

ITALY

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ITALIAN AWARDS

The rules of the Marco Polo Award already have been published in *73* and here is the follow-up of the results of North American stations. The US leader is WB3CQN with 151 points, followed by WA3HUP with 148 points and WB4UBD, 131 points, W7ULC, 129 points, and N3KR, 87 points.

Also, the rules of the Italian Islands Award have been in *73*. It is not an easy certificate, but a couple US stations have managed to get it. They are N3BGY and W1RFW for the moment, but we are waiting for more applications considering that this summer there has been much activity from the islands and many contacts have been made with Ws.

ISLANDS FOR VACATION

Italy is surrounded by the sea and, particularly in the south, there are large and small islands. It has become a habit here to take the holidays during July or August and to go south. Many of the people working in the big industrial towns originate from the south and they just go back to see the relatives and the birthplace. The others go simply for the beauty of the coasts and of the sea, for the nice food, and for the sun (Sicily is on the same line as Algeria or Tunisia). So when the big factories close for 3 or 4 weeks (all of them together, unluckily), millions of cars take the speedways to the south.

I remember a friend in Los Angeles showing me a traffic jam and saying it was an American invention. I am sorry to say that here it has become an art. You can spend hours traveling at just 10 mph while the speed limit is 90.

The distance from Milano to Sicily is 1000 miles, more or less, and you have to cross the sea and then make another short trip inland and then take another boat if you want to get to one of the beautiful islands surrounding Sicily. But when you arrive you can really rest, enjoy the wine and the fish, sail, look for girls, and perhaps spend some time with the radio.

This is becoming more and more popular since the start of the Italian Island Award, and this summer it was possible to work more than 10 different islands in the different seas.

One of the operations has been from the Tremiti group with the callsign I2DMK/IL7. He has activated all 5 islands of the group, as each one is valid for the award. The largest of them is San Domino—where a population of 70 becomes 1000 during summer.

Another good prefix was IA5DFS, during July, the same period as the mini-expedition of I2PFY/ID9 and ID7UDB.

In August, it was possible to catch IM0LYN, I3ON/ID9, IT9ZRQ/IG9, IT9HLO/IF9, I2KAJ/IG9, IP1GJK, and IM0WON.

The photo shows the Linosa camp in the IG9 group, activated during August.

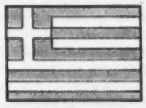
It has become a popular sport to do some ham radio from an island, and it will be the same again next year; if you want any details please write me, and if you plan to come to Italy next summer, I can put you in contact with some of the local people. You will surely enjoy the warm southern people.

THE FIRST YL STATION FROM 3V8

From July 27 to August 8 there was an operation from Tunisia with the callsigns 3V8ZY and 3V8AI. Operators were Dieter IN3RZY and Angela, his wife, IN3XAI. They have operated from the shack of 3V8PS, the only station in Tunisia, of which Dieter is the QSL manager.

Angela is the first YL who has been active from Tunisia and therefore has been much requested on the air. They had 6600 QSOs with 140 countries worked and very poor propagation. You can QSL to their home address. The operation has already received the OK from the ARRL desk.

3V8PS has been in Tunisia a couple of years and is very active on all bands, mainly SSB. He works with an ICOM 720 and a 2-element beam, so his signal is not too strong, but he has managed to get 230 countries and is always looking for a new one. It's very easy to find him at 14213 kHz talking to his manager. The photo shows Angela in the garden of the house.



GREECE

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Greece

By the time you read this, the Radio Am-

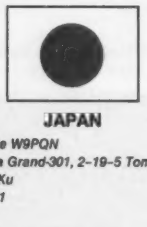
The DXpedition camp on Linosa Island.

Angela IN3XAI in Tunisia.

ateur Association of Greece will be at a new address. So people who would like to contact RAAG officials will now have to use the address: RAAG, 23-24, Platia Eleftherias, 105 53 Athens, Greece. The offices will be on the third floor, but at the time of writing I don't know the new phone numbers. I will pass them along in my next column. Keep in mind that you can always use the address: RAAG, PO Box 3564, 102 10 Athens, Greece, as this one is not changing.

When on the band you hear a J4 prefix, don't panic and start looking at your DXCC Countries List for the new one. It is Greece, alright, and this prefix is given on special occasions such as contests, celebrations, etc. By the way, in the last WPX contests, some of my SV fellows participated, and from the first results according to *CQ* magazine, it looks like Greece is going to have (for the first time in our amateur history) a winner as the top European scorer. The station is J41JG (or SV1JG, if you like). You may remember Cliff from my presentation in this column a few months ago. He scored 1,667,576 points, and as the evaluation of the contest logs still goes on at *CQ* headquarters, we don't know the final results, but I have a strong feeling that they will bring to J41JG the reward. Cliff was 10th in the single-operator, all-band category last year, and if he is not going to be the continental leader for this year, I'm sure he will have some similar position. Anyway, I still have my fingers crossed!

I have written this column for about a year now and you have probably noticed that I never mentioned anything about awards. Well, up to now (since a few years ago) Greece is not issuing any awards at all. There have been some in the past, but for a very complicated reason which is difficult to explain in these lines, they have stopped for maybe 6 years now. Anyway, as this all belongs to the past, there is a big effort for some new awards which will start again this RAAG's dead and buried activity.



JAPAN

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Japan

EARTHQUAKE

Until now, most offers by amateur-radio operators to assist in disasters in this country have been spurned or met with scoffs or outright ridicule. After all, "amateurs" are not "professionals" and are not really qualified, and they might even get in the way and impede the professionals in aiding the public during disasters—so the argument went. But is ham radio in this country finally coming of age?

In the early morning of September 14, 1984, a death-dealing earthquake registering six on the scale struck an area north of Tokyo (specifically, the village of Ohtaki in Nagano Prefecture). The thing to note here is that on September 18th, the Asahi newspaper, with a national circulation of over 9,000,000 (!), reported on the situation with a headline that announced, "...POOR EMERGENCY COMMUNICATIONS...HAM RADIO TOOK OVER!" That kind of publicity can't be bought at any price.

In recent years, ham radio, long thought by the general public to be the exclusive domain of schoolboys, has been gradually gaining attention and respect, much of that due to the JARL's singular efforts. Especially effective have been the articles regarding satellite communications, which seem to capture the imagination of laymen everywhere. But in Japan there is not a great amateur emergency network like RACES, that we have in the United States. Part of this is due, of course, to apathy on the part of the amateur-radio community, but mostly it is due to ignorance on the part of society as to just exactly what part amateur radio could play. And those who are apathetic can't be blamed either. As one Japanese ham told me, "No need to waste your effort trying to convince the local officials. We've tried, but they won't listen." But this may change now, although gradually, no doubt, as most changes in this country take half an eternity.

Anyway, let's get back to the Asahi story. The newspaper report explains that the residents of the village of Ohtaki, where the residences are scattered at the foot of Ontake Mountain, were actually all "tied together" with the village office by wire—in other words, a sort of public address system where the city officials make public announcements from time to time to the 427 families living there. There was also an ordinary telephone circuit. But when the quake hit, it hit with such force and magnitude that most of the poles holding the wires were either toppled or tilted, ripping out the wires for the entire system, including power lines.

Nearby, 140 employees of the Forestry Bureau who work in the mountains and forests in various scattered locations all escaped to safety. They were the main and most effective rescue group, as many of them are ham-radio operators. They, of course, played a major role in guiding citizens to safety and summoning help.

During the past few years, Ohtaki village had been considering the installation of an emergency radio communications system, but had not yet accumulated enough funds in the village budget.

Soon after the quake hit, some of the wired communications were restored, but three days later some homes were still without communications of any kind. There are some 40 wireless stations throughout the village including mobile stations in the fire engines. Base stations are located in the village office and in a public hall in the Takigoshi area in the far west. But Takigoshi couldn't use its transmitter because they are not equipped with a generator—and the power lines were down there, too. Therefore, 120 people in that area were completely isolated from the outside world.

There was one active radio emergency circuit between an adjacent city office in the prefecture and Ohtaki, but it was tied up continuously, talking to various departments and prefectural offices, and couldn't really give much information on damage areas and where help was needed. Here is where ham radio came to the rescue.

The forestry employees, located in several different areas, communicated with each other by ham radio on UHF as soon as it became apparent that a devastating earthquake was in progress. Some at first tried to get to the disaster areas in their vehicles, which are equipped with ham rigs, and made contact with other hams in Ohtaki, the hardest hit area. It soon became apparent that vehicles would be of little or no use as the quake had damaged many of the roads to the extent that they were no longer passable. As one observer put it, "The roads were all cut up." So they proceeded on foot to the hardest hit areas, reporting on the situation through their hand-helds as they walked.

This mobility enabled the various forestry groups to summon help and advise of areas where there were high-velocity landslides in progress, sudden swelling of streams and rivers, other areas to avoid, safe evacuation areas, areas that were not passable, and determining the areas where help was not needed and to recruit help from those areas and direct those people to places where immediate help was needed. The ham rigs of these forestry people became the main emergency network. Some hams in the village refrained from transmitting, but carefully noted the information they heard and passed it on to the village officials and others in charge of disaster rescue operations. One important link was a forestry station location at midpoint that acted as relay between points where signals were weak.

Because of the efforts of these men and their ham rigs, many people were able to escape to safety and many others were pulled from rubble and mud, resulting in saved lives. In spite of these commendable efforts, two weeks after the quake hit the toll was 8 dead and 21 missing, which gives us an idea how strong and destructive an earthquake it was.

Departing from the Asahi newspaper report, my own comments are that I would hope that this story might encourage ham groups to once again resume their efforts to form emergency groups. Each Field Day (in Japan it's the first weekend in August) is well attended by various eager groups around the country. I wonder how many people realize that the real intended purpose of Field Day is to practice emergency communications?

It is a sad commentary on us human beings that it often takes violent events such as death and destruction to open our eyes and hearts. It would even be sadder if, in spite of that, we did nothing.

NEW ZEALAND

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New Zealand

A very busy month at this QTH! What with weekend conferences for a first aid organization that I am concerned with, a reunion of old retired Post Office Mail Section employees in Auckland, where I worked in the Mail Section for 30 years, and being installed as first principal of my chapter, I haven't had much time to research a special topic for the column. However, I have borrowed a few paragraphs from our local amateur magazine, *Break-In*, that I thought might prove of interest to *73* readers.

BITS 'N' PIECES

AMSAT-UK was host recently to an amateur satellite planning meeting at Cheltenham, England. Representatives from European and worldwide satellite groups were present, including G3YJO, W3GEY, DJ4ZC, KA9Q, KE3D, HA5WH, W4PUJ, NK6K, VE1SAT/VE6, G8DQX, DK1YQ, ZS6BNT, and ZL1AOX. The group discussed many topics and technologies pertaining to satellites, as well as information dissemination and fund raising. The formation of an "Amateur Satellite Service Council" was proposed to expedite the topics discussed with representation from all bona fide amateur satellite groups worldwide. Further details of this Council will be provided when the draft proposal is refined.

From the meeting in England, Ian ZL1AOX, VE1SAT/VE6, KA9Q, and DK1YQ went on to Marburg, Germany (headquarters of AMSAT-DL) for an intensive Controller Command training session with Karl Mainzer DJ4ZC. As a result of the training, Ian and the others are now authorized to undertake the full range of attitude and control commands associated with the long-term control of OSCAR 10. A major advantage of the increased number of command stations is that the general beacon information can now be updated weekly, bringing more information more quickly to eagerly-awaiting users.

Special Victorian Callsign—From early November, the call VK3WI will be heard on all bands in SSB, CW, and RTTY. This call will be operated by the Wireless Institute of Australia (Victorian Division) to commemorate the 150th anniversary of the State of Victoria. The call will be used for a period of approximately six months. QSL to VK3WI, 412 Brunswick Street, Fitzroy, 3065, Australia, or via the Bureau.

Changes in Vanuatu—The Vanuatu P and T Department is to tighten up on licensing procedures in the Republic and, in addition, carry out stiffer policing of radio operations within the Territory. The YJ0 prefix will be allocated to nonresident and short-term bona fide amateurs who can produce documentary evidence from one of the major countries that have amateur status. Long-term residents, including expatriates on long-term employment, will continue to be allocated two-letter calls with the YJ8 prefix. The YJ0 calls will consist of three suffix letters in the series YJ0AAA to YJ0AAZ. Any marine mobile (. . ./MM) calls will be valid for use only within Vanuatu waters.

From ZK-Land—Victor ZK1CG has been operating on RTTY with gear kindly donated by Gin JA1ACB, but unfortunately is off RTTY for a while until he acquires a green or amber screen monitor, then he will be back on the air on RTTY again.

Victor and his XYL, Marsha, are Mine Hosts of Tiare Village Holiday Chalets near the airport of Rarotonga and Avarua town. Included in the amenities offered by Tiare Village is the hire of ham radio to any licensed operator. Write to Victor Rivera at Box 489, Rarotonga, if you desire information to obtain a ZK1 license for use on a Rarotongan holiday. Take your own 2-meter gear to work via OSCAR.

The March of Time—It is 60 years since the first contact between Ivan O'Meara 2AC and C. Braggio CB8 in Argentina on May 22, 1924, and Frank Bell ZL4AA's two-way contact with American 6BCB on September 21, 1924, and also his two-way contact with Cecil Goyder 2GZ on October 18, 1924!

VHF Activity—6-meter activity in this area has finally slowed down to the expected level for a "minima" sunspot year. Only sporadic-E, tropo, and meteor-scatter propagation noted, with only VK, ZL, and FK8 being worked consistently. The VK2RSY beacon was copied in New Plymouth on several occasions during the late-May to mid-July period with good signal strengths ranging from 5 × 4 through to 5 × 9 + 10 dB, giving a good indication of sporadic-E propagation between ZL and VK on those occasions. ZL DX on 2 meters was minimal during this period, but a surprising amount of tropospheric ductiontype of propagation still took place, and could be monitored by watching the 2m beacons and FM repeaters.

Exams—The first of the new-style amateur examinations mentioned in a recent column has come and gone; from local comment in this area, the candidates seem happy with the format, and to this

date no adverse comments have been heard. Time will tell, though, especially when the results come out, as that's when most of the postmortems take place.

OTC Silent Keys reported this month are Henry Bunn ZL1JY, ex ZL1HO and ZL2SU, on July 23, 1984, aged 78, W. (Bill) Crook ZL4LT at Milton, Otago, another long-serving amateur, and Anthony Blake ZL1RQ, on July 18, 1984, aged 71 years. All these old-timers had had many years of active service in the ranks of amateur radio in New Zealand.

I trust that all readers enjoyed a very happy Christmas and that the coming New Year will be prosperous, happy, and bountiful for all. As I have said before, we are in the midst of our summer here in this hemisphere, enjoying long sunny days and pleasant evenings—I trust you all in the north are having a reasonable holiday period, too.

Happy New Year to all from us here "down under" in ZL-land.

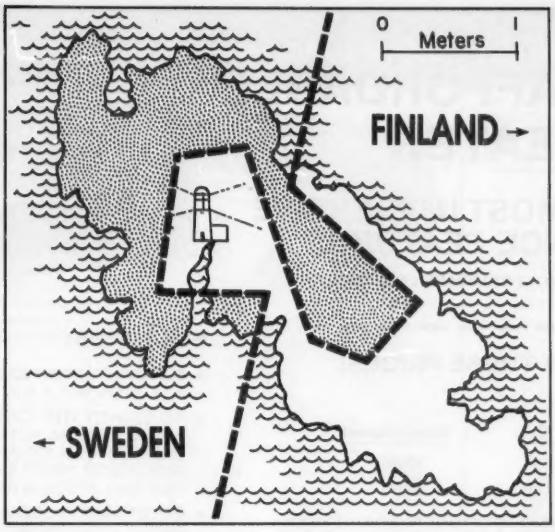

Fig. 1.

POLAND

Jerzy Szymczak
78-200 Bialogard
Buczka 2/3
Poland

Debaters attending electoral meetings taking place in clubs and District Boards of PRAA rightfully appreciated the work of many hams—activists under hard conditions of martial law. The majority of members of District Boards were reelected delegates to the National Congress of PRAA that took place at the end of 1984. Actual members of Presidium and Headquarters of PRAA took part in electoral meetings to make notes of demands for the State Radio Surveillance, the Ministry of Communications, and PRAA itself. Participants of the assemblies brought forward first drafts of improvements of an inadequate organization, an acceleration of the technical information turnover. They discussed a possibility of giving Polish hams access to the new amateur bands, 10, 18, and 24 MHz, and demanded facilities for working on another QTH without special permission. They wanted to take for granted a QRZ in motion at least on UHF.

Serious financial difficulties, particularly of poorer clubs, brought discussion on the problem of an increase of membership fees.

The Deputy Chairman of the PRAA in charge of technical matters, Jerzy Niewada SP7HF, died on April 26, 1984.

Ryszard Reich SP4BBU resigned his office of the Deputy Chairman of PRAA Headquarters in charge of organization affairs. Wiktor Chojnacki SP5QU took the office.

April 8–13, 1984, the general conference of the 1st Region of IARU took place in the hotel Costa Verde (Sicily). Prof. Dr. Eng. Andrzej Zielinski SP5LVV, the President of PRAA, and Assistant Prof. Dr. Janusz Konopka SP5JC, the Microwave Manager of PRAA, represented Poland at the conference. Moreover, Wojciech Nietyksza SP5FM, Vice-President of the Executive Committee of the 1st Region, M. Eng. Henryk Cichon SP9ZD, the President of the working group in charge of electromagnetic compatibility, and M. Eng. Krzysztof Slomczynski SP5HS, the President of the working group in charge of amateur radiolocation, were present, too. Wojciech Nietyksza of the 1st Region was reelected the Vice-President.

In March and April this year there took place successive UHF competitions, "Activity Day SP." Inspired by PRAA, it brought together 150 radio stations on 144 MHz and 8 stations on 432 MHz (in March) and 142 stations on 144 MHz, 8 stations on 432 MHz (in April). In the March contest, senior category, winners were SP6GZZ, SP6AZT, and SP2DDV and junior category, SP3MFI, SP3MFJ, and SP3MLK (on 144 MHz). On 432 MHz, senior, SP6AZT, SP6GWN, SP9BGS, and SP9EWO won. SP6MLK worked on 432 MHz in the junior category.

In the April contest on 144 MHz, senior category, winners were SP6GZZ, SP3GCL, and SP6AZT, while SP3MFI, SP3MIE, and SP3MFJ won in the junior group. On 432 MHz, senior, SP6AZT, SP6GWN, and SP6CIY won. As in the previous month, only one junior was on 432 MHz, SP6MLK. After competitions, SP6GZZ had 3442 points and SP3MFI had 1271 points in the 144-MHz category, and SP6AZT had 63 points in the 432-MHz category.

SWEDEN

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Sweden

MARKET REEF OJ0 NOW IN FINLAND

For over 90 years a Finnish lighthouse has been standing on the Swedish side of the small rocky island called Market Reef, 300 meters long and 100 meters wide, in the Baltic Sea between the Swedish mainland and Aaland Island, Finland. the border line was drawn after the peace treaty in 1809 when Sweden had to give up possession of Finland to Russia. In 1875, Finland built a lighthouse on this reef, which happened to be placed on the Swedish part of the island.

Every 25 years national border lines are checked over. Not until the latest check, in 1981, was the discovery made that Finland was using a part of the Market Reef that in fact belonged to the Royal Kingdom of Sweden! Now, in 1984, this problem has been settled and the border line has been redrawn (see Fig. 1). The amateur-radio operations from OJ0, valid as a separate DXCC country, will from now on be from the correct side of the national border!

CW ACTIVITY GROUP

In 1974, a group of Scandinavian radio amateurs formed the Scandinavian CW Activity Group, SCAG. During the early seventies, there was a noticeable decrease in ham activity on the low-frequency shortwave bands here. Two possible reasons were the introduction of 2-meter FM repeaters and the new code-free VHF license. The forming of SCAG was intended to give new enthusiasm to the low-band activity, especially on CW.

Message Handling

Due to the restrictions put on the ham operators in Region 1, we have very few possibilities in making our activities recognized by the authorities and the general public. Most countries have a state monopoly for telecommunications. This has made sending of radiograms between third parties through ham radio impossible. However, SCAG started nets for message handling for practicing purpose.

In contrast to the USA, we do not regard another ham operator as a third party. This makes it possible for us to relay messages to other ham operators in our nets. In a possible emergency it is important that all participants in a net are familiar with the procedures in order to get messages handled efficiently. If you have no practice, the risk is that you mess it all up. In the beginning some hams here were afraid of participating because they thought it would not be accepted by the authorities. However, the licensing authorities in the Scandinavian countries have stated that the way SCAG handles messages, for hams, between hams, does not violate the third-party restriction in the radio regulations. Unfortunately, in the USA a ham operator not contacted directly is regarded as a third party. This makes it impossible for us to expand our nets on a broader basis.

Four times a year SCAG issues a newsletter. The editor, Borge OZ2NU, has been doing a good job through the years. The new editor now is Gunnar SM6AWA and the president for the group is Holger SM7GNF.

SCAG was started by some dedicated Swedish hams, and among those working hard to get the activities going were Frasse SM5TK, Sven SM0IX, and Kjell SM0CCE. Further on, some Danish hams got interested and Eric OZ8O and Rick OZ5RM have over the years kept SCAG growing in Denmark. For some reasons, difficult to pinpoint, the Norwegian and Finnish hams have not been hooked by this SCAG idea and only a few LA and OH hams are members of the group.

SCAG activities include Straight Key Day twice a year with increasing popularity, rag-chew and slow-speed nets, and nets for message handling. From time to time the group arranges other activities and issues various awards like Worked SCAG Areas and SCAG Rag-Chew Award. SCAG Net Manager, Rolf SM6NFF, is trying to start a DX net with the USA and Canada on 14.055 MHz at 1430 UTC Sundays.

The SCAG motto is to support and encourage amateur radio telegraphy and to work for good operating behavior on the ham bands. The group celebrated its 10th anniversary in 1984 and will continue its efforts in bringing more hams closer together.

HAM HELP

I would like to hear from anyone who has converted a Cobra 146GTL to 10-meter SSB/AM, or a Cobra 21XLR to 10-meter FM.

Robert Good N0FFF
6134 SE 80th St.
Berryton KS 66409

I need several items: parts for an HP-608, an address for the Jerrold Antenna Corporation, and service manuals for an IBM model B typewriter and a 3M model 149 copier.

Kevin Neal
Route A, Box 221A
Flippin AR 72634

I need the manual, schematic, and parts list for the Millivac Instruments, Inc., model 77B dc multimeter. I also need the attachment that goes to the panel jack marked Output. I will gladly pay mailing and/or copying costs.

Vernon Jones WB1BVH
32 Cat Mousam Road
Kennebunk ME 04043

I am in desperate need of a shop manual for a Motorola Multi-XFL portable repeater. It is possibly an SP version of the Lookout repeater and was manufactured in 1973. I'll pay all costs incurred.

Derek W. Kelly
100 Sylvan Court
Alexandria VA 22304
(703)-765-5227

THE MOST AFFORDABLE REPEATER

ALSO HAS THE MOST IMPRESSIVE PERFORMANCE FEATURES

(AND GIVES THEM TO YOU AS STANDARD EQUIPMENT!)

JUST LOOK AT THESE PRICES!

Band	Kit	Wired/Tested
10M,6M,2M,220	$680	$880
440	$780	$980

Both kit and wired units are complete with all parts, modules, hardware, and crystals.

CALL OR WRITE FOR COMPLETE DETAILS.

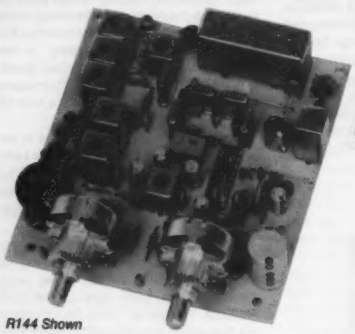
Also available for remote site linking, crossband, and remote base.

FEATURES:

- SENSITIVITY SECOND TO NONE; TYPICALLY 0.15 uV ON VHF, 0.3 uV ON UHF.
- SELECTIVITY THAT CAN'T BE BEAT! BOTH 8 POLE CRYSTAL FILTER & CERAMIC FILTER FOR GREATER THAN 100 dB AT ± 12KHZ. HELICAL RESONATOR FRONT ENDS. SEE R144, R220, AND R451 SPECS IN RECEIVER AD BELOW.
- OTHER GREAT RECEIVER FEATURES: FLUTTER-PROOF SQUELCH, AFC TO COMPENSATE FOR OFF-FREQ TRANSMITTERS, SEPARATE LOCAL SPEAKER AMPLIFIER & CONTROL.
- CLEAN, EASY TUNE TRANSMITTER; UP TO 20 WATTS OUT (UP TO 50W WITH OPTIONAL PA).

HIGH QUALITY MODULES FOR REPEATERS, LINKS, TELEMETRY, ETC.

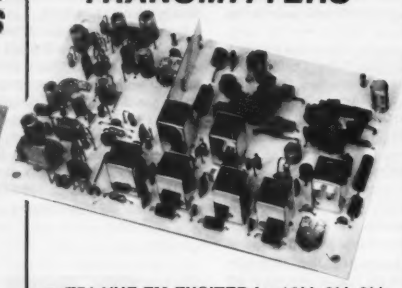
HIGH-PERFORMANCE RECEIVER MODULES



R144 Shown

- **R144/R220 FM RCVRS** for 2M or 220 MHz. 0.15uV sens.; 8 pole xtal filter & ceramic filter in hf, helical resonator front end for exceptional selectivity, more than −100 dB at ±12 kHz, best available today. Flutter-proof squelch. AFC tracks drifting xmtrs. Xtal oven avail. Kit only $138.
- **R451 FM RCVR** Same but for uhf. Tuned line front end, 0.3 uV sens. Kit only $138.
- **R76 FM RCVR** for 10M, 6M, 2M, 220, or commercial bands. As above, but w/o AFC or hel. res. Kits only $118. Also avail w/4 pole filter, only $98/kit.
- **R110 VHF AM RECEIVER** kit for VHF aircraft band or ham bands. Only $98.
- **R110-259 SPACE SHUTTLE RECEIVER,** kit only $98.

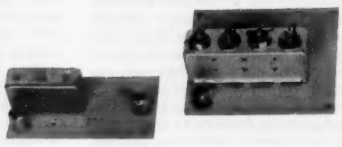
TRANSMITTERS



- **T51 VHF FM EXCITER** for 10M, 6M, 2M, 220 MHz or adjacent bands. 2 Watts continuous, up to 2½ W intermittent. $68/kit.

- **T451 UHF FM EXCITER** 2 to 3 Watts on 450 ham band or adjacent freq. Kit only $78.
- **VHF & UHF LINEAR AMPLIFIERS.** Use on either FM or SSB. Power levels from 10 to 45 Watts to go with exciters & xmtg converters. Several models. Kits from $78.
- **A16 RF TIGHT BOX** Deep drawn alum. case with tight cover and no seams. 7 x 8 x 2 inches. Designed especially for repeaters. $20.

ACCESSORIES



- **HELICAL RESONATOR FILTERS** available separately on pcb w/connectors.

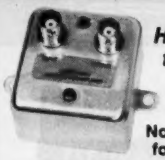
  HRF-144 for 143-150 MHz $38
  HRF-220 for 213-233 MHz $38
  HRF-432 for 420-450 MHz $48

- **COR-2 KIT** With audio mixer, local speaker amplifier, tail & time-out timers. Only $38.
- **COR-3 KIT** as above, but with "courtesy beep". Only $58.
- **CWID KITS** 158 bits, field programmable, clean audio, rugged TTL logic. Kit only $68.
- **DTMF DECODER/CONTROLLER KITS.** Control 2 separate on/off functions with touchtones®, e.g., repeater and autopatch. Use with main or aux. receiver or with Autopatch. Only $90
- **AUTOPATCH KITS.** Provide repeater autopatch, reverse patch, phone line remote control of repeater, secondary control via repeater receiver. Many other features. Only $90. Requires DTMF Module.

- **NEW – SIMPLEX AUTOPATCH** Use with any transceiver. System includes DTMF & Autopatch modules above and new Timing module to provide simplex autopatch and reverse autopatch. Complete patch system only $200/kit. Call or write for details.

hamtronics®

NEW LOW-NOISE PREAMPS



Hamtronics Breaks the Price Barrier!

*

No Need to Pay $80 to $125 for a GaAs FET Preamp.

FEATURES:

- Very Low Noise: 0.7 dB VHF, 0.8 dB UHF
- High Gain: 18 to 28 dB, Depending on Freq.
- Wide Dynamic Range for Overload Resistance
- Latest Dual-gate GaAs FET, Stable Over Wide Range of Conditions
- Rugged, Diode-protected Transistors
- Easy to Tune
- Operates on Standard 12 to 14 Vdc Supply
- Can be Tower Mounted

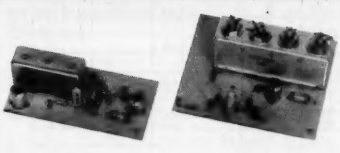
MODEL	TUNES RANGE	PRICE
LNG-28	26-30 MHz	$49
LNG-50	46-56 MHz	$49
LNG-144	137-150 MHz	$49
LNG-220	210-230 MHz	$49
LNG-432	400-470 MHz	$49
LNG-40	30-46 MHz	$64
LNG-160	150-172 MHz	$64

ECONOMY PREAMPS

Our traditional preamps, proven in years of service. Over 20,000 in use throughout the world. Tuneable over narrow range. Specify exact freq. band needed. Gain 16-20 dB. NF = 2 dB or less. VHF units available 27 to 300 MHz. UHF units available 300 to 650 MHz.

- P30K, VHF Kit less case $18
- P30W, VHF Wired/Tested $33
- P432K, UHF Kit less case $21
- P432W, UHF Wired/Tested $36

HELICAL RESONATOR PREAMPS



Our lab has developed a new line of low-noise receiver preamps with helical resonator filters built in. The combination of a low noise amplifier and the sharp selectivity of a 3 or 4 section helical resonator provides increased sensitivity while reducing intermod and cross-band interference in critical applications. See selectivity curves at right. Gain = approx.12 dB.

Model	Tuning Range	Price
HRA-144	143-150 MHz	$49
HRA-220	213-233 MHz	$49
HRA-432	420-450 MHz	$59
HRA-( )	150-174MHz	$69
HRA-( )	450-470 MHz	$79

RECEIVING CONVERTERS

Models to cover every practical rf & if range to listen to SSB, FM, ATV, etc. NF = 2 dB or less.

	Antenna Input Range	Receiver Output
VHF MODELS	28-32	144-148
	50-52	28-30
Kit with Case $49	50-54	144-148
Less Case $39	144-146	28-30
Wired $69	145-147	28-30
	144-144.4	27-27.4
	146-148	28-30
	144-148	50-54
	220-222	28-30
	220-224	144-148
	222-226	144-148
	220-224	50-54
	222-224	28-30
UHF MODELS	432-434	28-30
	435-437	28-30
Kit with Case $59	432-436	144-148
Less Case $49	432-436	50-54
Wired $75	439.25	61.25

SCANNER CONVERTERS Copy 72-76, 135-144, 240-270, 400-420, or 806-894 MHz bands on any scanner. Wired/tested Only $88.

SAVE A BUNDLE ON VHF FM TRANSCEIVERS!

FM-5 PC Board Kit – **ONLY $178** complete with controls, heatsink, etc. 10 Watts, 5 Channels, for 2M or 220 MHz.

Cabinet Kit, complete with speaker, knobs, connectors, hardware. Only $60.

REPEAT OF A SELLOUT!

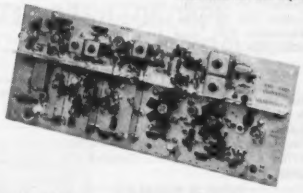
While supply lasts, get $60 cabinet kit free when you buy an FM-5 Transceiver kit. Where else can you get a complete transceiver for only $178

TRANSMIT CONVERTERS

For SSB, CW, ATV, FM, etc. Why pay big bucks for a multi mode rig for each band? Can be linked with receive converters for transceive. 2 Watts output vhf, 1 Watt uhf.

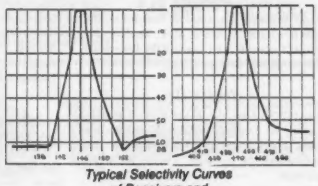
	Exciter Input Range	Antenna Output
For VHF,	28-30	144-146
Model XV2	28-29	145-146
Kit $79	28-30	50-52
Wired $149	27-27.4	144-144.4
(Specify band)	28-30	220-222*
	50-54	220-224
	144-146	50-52
	50-54	144-148
	144-146	28-30
For UHF,	28-30	432-434
Model XV4	28-30	435-437
Kit $99	50-54	432-436
Wired $169	61.25	439.25
	144-148	432-436*

*Add $20 for 2M input



VHF & UHF LINEAR AMPLIFIERS. Use with above. Power levels from 10 to 45 Watts. Several models, kits from $78.

LOOK AT THESE ATTRACTIVE CURVES!



Typical Selectivity Curves of Receivers and Helical Resonators.

IMPORTANT REASONS WHY YOU SHOULD BUY FROM THE VALUE LEADER:

1. *Largest selection of vhf and uhf kits in the world.*
2. *Exceptional quality and low prices due to large volume.*
3. *Fast delivery; most kits shipped same day.*
4. *Complete, professional instruction manuals.*
5. *Prompt factory service available and free phone consultation.*
6. *In business 21 years.*
7. *Sell more repeater modules than all other mfrs. and have for years. Can give quality features for much lower cost.*

- **Call or Write for FREE CATALOG**
- (Send $1.00 or 4 IRC's for overseas mailing)
- Order by phone or mail ● Add $3 S & H per order
(Electronic answering service evenings & weekends)
Use VISA, MASTERCARD, Check, or UPS COD.

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65-D MOUL RD. ● HILTON NY 14468

Phone: 716-392-9430

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DEALER DIRECTORY

Culver City CA

Jun's Electronics, 3919 Sepulveda Blvd., Culver City CA 90230, 390-8003. Trades 463-1886 San Diego, 827-5732 (Reno NV).

Fontana CA

Complete lines ICOM, DenTron, Ten-Tec, Mirage, Cubic, Lunar, over 4000 electronic products for hobbyist, technician, experimenter. Also CB radio, landmobile. **Fontana Electronics, 8628 Sierra Ave., Fontana CA 92335, 822-7716.**

San Jose CA

Bay area's newest amateur radio store. New & used amateur radio sales & service. We feature Kenwood, ICOM, Azden, Yaesu, Ten-Tec, Santec & many more. **Shaver Radio, Inc., 1775A S. Winchester Blvd., Campbell CA 95008, 370-6565.**

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Factory Authorized Dealer! Yaesu, ICOM, Ten-Tec, KDK, Kenwood, AEA, Kantronics, Santec. Full line of accessories. No sales tax in Delaware. One mile off I-95. **Delaware Amateur Supply, 71 Meadow Road, New Castle DE 19720, 328-7728.**

Boise ID

Rocky Mountain area's newest ham dealer. Call RJM first for AEA, Azden, KDK, Ten-Tec, Butternut, Cushcraft, and more! **RJM Electronics, 4204 Overland, Boise ID 83705. 343-4018.**

Preston ID

Ron WB7BYZ has the largest stock of amateur gear in the Intermountain West and the best prices. Call me for all your ham needs. **Ron Distributing, 78 So. State, Preston ID 83263, 852-0830.**

Littleton MA

The reliable ham store serving NE. Full line of ICOM & Kenwood. Yaesu HTs, Drake, Daiwa, B&W accessories. Curtis & Trac keyers. Larsen, Hustler, Telex/Hy-Gain products. Mirage amps., Astron P.S., Alpha Delta protectors, **ARRL & Kantronics** instruction aids. Whistler radar detectors. Full line of coax fittings. **TEL—COM Electronic Communications, 675 Great Rd. (Rt. 119), Littleton MA 01460, 486-3400/3040.**

Lincoln NE

C&C Communications is a full-line distributor of major-line amateur equipment and accessories, antennas, and everything. **4230 Progressive Ave., Lincoln NE 68504, 46-RADIO.**

Derry NH

Serving the ham community with new and used equipment. We stock and service most major lines: AEA, Astron, Azden, B&W, Cushcraft, Hy-Gain, Hustler, ICOM, Kenwood, KLM, Larsen, Mirage, Mosley; books, rotors, cable and connectors, Busines hours 9–7 Monday through Thursday, and 9–5 Friday and Saturday. **Rivendell, 68 Warner Hill Road, Derry NH 03038; 434-5371.**

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UPSTATE NEW YORK

Kenwood, ICOM, Ten-Tec, Belden, Cushcraft, Larsen, Hustler, ARRL, Hy-Gain, B&W, MFJ, Mirage. New and used equipment. Serving the amateur community since 1942. **Adirondack Electronics, Inc., 1991 Central Avenue, Albany NY 12205, 456-0203** (one mile west of Northway exit 2W).

Columbus OH

The biggest and best ham store in the Midwest featuring Kenwood and other quality products with working displays. We sell only the best. Authorized Kenwood service. **Universal Amateur Radio, Inc., 1280 Aida Dr., Reynoldsburg (Columbus) OH 43068, 866-4267.**

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IBM PC/XT kits, supplies, expansion products; video restorer kits for pay TV, CATV, satellite hobbyists' electronic project kits/appnotes. More than 9000 parts in stock: semiconductors, ICs, discretes, video accessories, tools, audio, automotive, cabinets, computer peripherals. Please write for your free 60-page catalog: **Sabet Electronics, 13650 Floyd Rd., Ste. 104, Dallas TX 75243; 783-4950 (formerly I.E.).**

DEALERS

Your company name and message can contain up to 25 words for as little as $150 yearly (prepaid), or $15 per month (prepaid quarterly). No mention of mail-order business or area code permitted. Directory text and payment must reach us 60 days in advance of publication. For example, advertising for the April '85 issue must be in our hands by February 1st. Mail to 73 Magazine, Peterborough NH 03458. ATTN: Nancy Ciampa.

PROPAGATION

Jim Gray W1XU
73 Staff

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15						20	20A	15			
ARGENTINA	20										15	15
AUSTRALIA	20					40	40			20	20	15
CANAL ZONE	40	40					20	15	15	15	15	20
ENGLAND	40	40	40	80	80		20	15	15	15	20	
HAWAII	20					40	20	20			15	15
INDIA							20	20				
JAPAN	15						20	20				15
MEXICO	40	40	40	40	40	40	20	15	15	15	15	20
PHILIPPINES							20	20				
PUERTO RICO	40	40	40	40	40	40	20	15	15	15	15	20
SOUTH AFRICA	40A	40						15	15	20		
U. S. S. R.		40						15	15	20		
WEST COAST	15	20	40	40	40	40	40A	20A	15	15	15	15

CENTRAL UNITED STATES TO:

ALASKA	20				40	40	20	20				20
ARGENTINA	20	40	40	40						15	15	20A
AUSTRALIA	15					40	20	20	20		15	15
CANAL ZONE	20		40	40	40			20	15	15	15	15
ENGLAND	40	40	80	80				15	15	15	20	
HAWAII	20	20			40	40	20	20	20	15	15A	15A
INDIA								20				
JAPAN	20				40	40	20	20				20
MEXICO	20		40	40	40			20	15	15	15	15
PHILIPPINES	20							20	20			
PUERTO RICO	20		40	40	40			20	15	15	15	15
SOUTH AFRICA	20	40	40						15	15	15	20
U. S. S. R.		40	40					15	15	20		

WESTERN UNITED STATES TO:

ALASKA	15	15	20			40	40	40				20
ARGENTINA	20	20		40	40						15	15
AUSTRALIA	15	15	20				40		20	20	20	15
CANAL ZONE	20	20		40	40	40	40	40	15	15	15	15
ENGLAND			40	40					20A	20A		
HAWAII	15	20	20			40	40	40				15
INDIA		20	20									
JAPAN	15	15	20				40	40	40			20
MEXICO	20	20		40	40	40	40	40				15
PHILIPPINES	20A	20								20		
PUERTO RICO	20	20		40	40	40	40	40				15
SOUTH AFRICA	20	20							15	15	15	20
U. S. S. R.								20	20	20	20	
EAST COAST	15	20	40	40	40	40	20	20A	15	15	15	15

A = Next higher frequency may also be useful.
B = Difficult circuit this period.

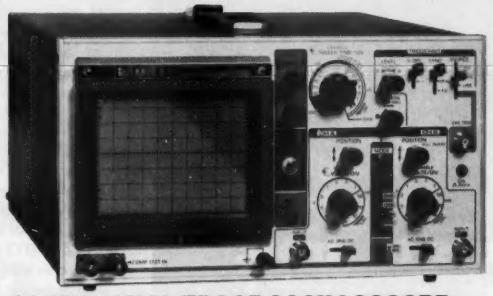
G = Good, F = Fair, P = Poor.

JANUARY

SUN	MON	TUE	WED	THU	FRI	SAT
		1 G	2 G	3 G-F	4 F-P	5 P
6 F	7 P-F	8 F-G	9 G-F	10 F	11 G	12 G
13 G	14 G	15 G	16 P	17 P	18 F	19 P-F
20 F	21 F-G	22 G	23 G	24 G	25 F	26 P
27 P	28 P-F	29 F-G	30 F	31 F-G		

RAMSEY

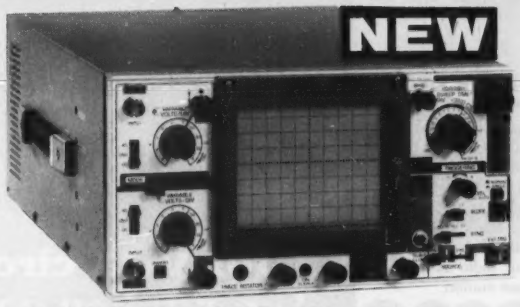
THE FIRST NAME IN ELECTRONIC TEST GEAR



20 MHz DUAL TRACE OSCILLOSCOPE

Unsurpassed quality at an unbeatable price, the Ramsey oscilloscope compares to others costing hundreds more. Features include a component testing circuit for resistor, capacitor, digital circuit and diode testing. • TV video sync filter • wide bandwidth & high sensitivity • internal graticule • front panel trace rotator • Z axis • high sensitivity x-y mode • regulated power supply • built-in calibrator • rock solid triggering • **USA—Add $10.00 per unit for postage, overseas orders add 15% of total order for Insured Surface Mail**

$399.95* high quality hook on probes included



45 MHz DUAL SWEEP OSCILLOSCOPE

The Ramsey 625 is a dual time base, delayed sweep unit that includes a built-in signal delay line to permit clear viewing during very short rise times of high frequency waveforms. Other features include; variable trigger holdoff • 20 calibrated sweep time ranges from 0.5 s/div to 0.2 μS/div. • fully adjustable sweep time • X5 sweep magnification • five trigger sources; CH1, CH2, LINE EXTernal and INTernal (V mode) • front panel x-y operation, Z axis input • sum difference of CH1, and CH2 waveforms displayed as single trace • sweep gate and sweep output • auto focus • single sweep • **USA—Add $10.00 per unit for postage, overseas orders add 15% of total order for Insured Surface Mail.**

$799.95* high quality hook on probes included

RAMSEY D-1100 VOM MULTITESTER

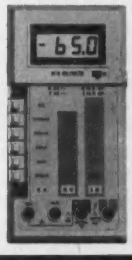
Compact and reliable, designed to service a wide variety of equipment. Features include • mirror back scale • double-jeweled precision moving coil • double overload protection • an ideal low cost unit for the beginner or as a spare back-up unit.

$19.95 test leads and battery included

NEW RAMSEY 1200 VOM MULTITESTER

Check transistors, diodes and LEDs with this professional quality meter. Other features include; decibel scale • 20K volt metering system • 3½" mirrored scale • polarity switch • 20 measuring ranges • safety probes • high impact plastic case

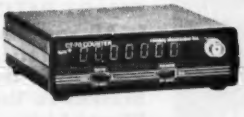
$24.95 test leads and battery included



RAMSEY D-3100 DIGITAL MULTIMETER

Reliable, accurate digital measurements at an amazingly low cost • in-line color coded push buttons, speeds range selection • abs plastic tilt stand • recessed input jacks • overload protection on all ranges • 3½ digit LCD display with auto zero, auto polarity & low BAT. indicator

$49.95 test leads and battery included



CT-70 7 DIGIT 525 MHz COUNTER

Lab quality at a breakthrough price. Features • 3 frequency ranges each with pre amp • dual selectable gate times • gate activity indicator • 50mV @ 150 MHz typical sensitivity • wide frequency range • 1 ppm accuracy

$119.95 wired includes AC adapter

CT-70 kit $99.95
BP-4 nicad pack 8.95

CT-90 9 DIGIT 600 MHz COUNTER

The most versatile for less than $300. Features 3 selectable gate times • 9 digits • gate indicator • display hold • 25mV @ 150 MHz typical sensitivity • 10 MHz timebase for WWV calibration • 1 ppm accuracy

$149.95 wired includes AC adapter

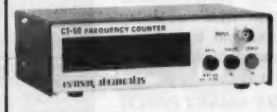
CT-90 kit $129.95
OV-1 0.1 PPM oven timebase 59.95
BP-4 nicad pack 8.95

CT-125 9 DIGIT 1.2 GHz COUNTER

A 9 digit counter that will outperform units costing hundreds more. • gate inicator • 24mV @ 150 MHz typical sensitivity • 9 digit display • 1 ppm accuracy • display hold • dual inputs with preamps

$169.95 wired includes AC adapter

BP-4 nicad pack 8.95



CT-50 8 DIGIT 600 MHz COUNTER

A versatile lab bench counter with optional receive frequency adapter, which turns the CT-50 into a digital readout for most any receiver • 25 mV @ 150 MHz typical sensitivity • 8 digit display • 1 ppm accuracy

$169.95 wired

CT-50 kit $139.95
RA-1 receiver adapter kit 14.95

DM-700 DIGITAL MULTIMETER

Professional quality at a hobbyist price. Features include 26 different ranges and 5 functions • 3½ digit, ½ inch LED display • automatic decimal placement • automatic polarity

$119.95 wired includes AC adapter

DM-700 kit $99.95
MP-1 probe set 4.95

PS-2 AUDIO MULTIPLIER

The PS-2 is handy for high resolution audio resolution measurements, multiplies UP in frequency • great for PL tone measurements • multiplies by 10 or 100 • 0.01 Hz resolution & built-in signal preamp/conditioner

$49.95 wired

PS-2 kit $39.95

PR-2 COUNTER PREAMP

The PR-2 is ideal for measuring weak signals from 10 to 1,000 MHz • flat 25 db gain • BNC connectors • great for shifting RF • ideal receiver/TV preamp

$44.95 wired includes AC adapter

PR-2 kit $34.95

PS-1B 600 MHz PRESCALER

Extends the range of your present counter to 600 MHz • 2 stage preamp • divide by 10 circuitry • sensitivity: 25mV @ 150 MHz • BNC connectors • drives any counter

$59.95 wired includes AC adapter

PS-1B kit $49.95

ACCESSORIES FOR RAMSEY COUNTERS

Telescopic whip antenna—BNC plug	$ 8.95
High impedance probe, light loading	16.95
Low pass probe, audio use	16.95
Direct probe, general purpose use	13.95
Tilt bail, for CT-70, 90, 125	3.95

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TERMS: • satisfaction guaranteed • examine for 10 days: if not pleased, return in original form for refund • add 6% for shipping and insurance to a maximum of $10.00 • overseas add 15% for surface mail • COD add $2.50 (COD in USA only) • orders under $15.00 add $1.50 • NY residents add 7% sales tax • 90 day parts warranty on all kits • 1 year parts & labor warranty on all wired units.

RAMSEY

RAMSEY ELECTRONICS, INC.
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Penfield, N.Y. 14626 ↵ 268

↵ See List of Advertisers on page 80

With SMART PATCH You are in CONTROL

With CES 510SA Simplex Autopatch, there's no waiting for VOX circuits to drop. Simply key your transmitter to take control.

SMART PATCH is all you need to turn your base station into a personal autopatch. SMART PATCH uses the only operating system that gives the mobile complete control. Full break-in capability allows the mobile user to actually interrupt the telephone party. SMART PATCH does not interfere with the normal use of your base station. SMART PATCH works well with any FM transceiver and provides switch selectable tone or rotary dialing, toll restrict, programmable control codes, CW ID and much more.

To Take CONTROL with Smart Patch – Call 800-327-9956 Ext. 101 today.

What To Look For In A Phone Patch

The best way to decide what patch is right for you is to first decide what a patch should do. A patch should:

- Give complete control to the mobile, allowing full break in operation.
- Not interfere with the normal operation of your base station. It should not require you to connect and disconnect cables (or flip switches!) every time you wish to use your radio as a normal base station.
- Not depend on volume or squelch settings of your radio. It should work the same regardless of what you do with these controls.
- You should be able to hear your base station speaker with the patch installed. Remember, you have a base station because there are mobiles. ONE OF THEM MIGHT NEED HELP.
- The patch should have standard features at no extra cost. These should include programmable toll restrict (dip switches), tone or rotary dialing, programmable patch and activity timers, and front panel indicators of channel and patch status.

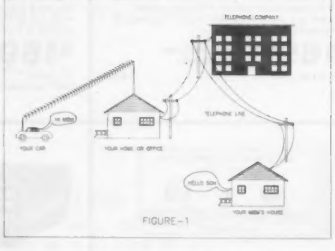
ONLY SMART PATCH HAS ALL OF THE ABOVE.

Now Mobile Operators Can Enjoy An Affordable Personal Phone Patch. . .

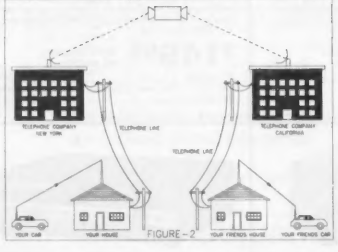
- Without an expensive repeater.
- Using any FM tranceiver as a base station.
- The secret is a SIMPLEX autopatch, The *SMART PATCH.*

SMART PATCH Is Easy To Install

To install *SMART PATCH*, connect the multicolored computer style ribbon cable to mic audio, receiver discriminator, PTT, and power. A modular phone cord is provided for connection to your phone system. Sound simple? . . . IT IS!



FIGURE–1



FIGURE–2

How To Use *SMART PATCH*

Placing a call is simple. Send your access code from your mobile (example: *73). This brings up the Patch and you will hear dial tone transmitted from your base station. Since *SMART PATCH* is checking about once per second to see if you want to dial, all you have to do is key your transmitter, then dial the phone number. You will now hear the phone ring and someone answer. Since the enhanced control system of *SMART PATCH* is constantly checking to see if you wish to talk, you need to simply key your transmitter and then talk. That's right, you simply key your transmitter to interrupt the phone line. The base station automatically stops transmitting after you key your mic. *SMART PATCH* does not require any special tone equipment to control your base station. It samples very high frequency noise present at your receivers discriminator to determine if a mobile is present. No words or syllables are ever lost.

SMART PATCH Is All You Need To Automatically Patch Your Base Station To Your Phone Line.

Use *SMART PATCH* for:

- Mobile (or remote base) to phone line via Simplex base. (see fig 1.)
- Mobile to Mobile via interconnected base stations for extended range. (see fig. 2.)
- Telephone line to mobile (or remote base).
- *SMART PATCH* uses SIMPLEX BASE STATION EQUIPMENT. Use your ordinary base station. *SMART PATCH* does this without interfering with the normal use of your radio.

WARRANTY?
YES, 180 days of warranty protection. You simply can't go wrong.
An FCC type accepted coupler is available for *SMART PATCH.*

CES® ✓462

Communications Electronics Specialties, Inc.
P.O. Box 2930, Winter Park, Florida 32790
Telephone: (305) 645-0474 **Or call toll-free (800)327-9956**

Presenting two small cases for a lot of mobile power.

You won't find a 45-watt, 2-meter FM mobile rig that's built smaller than the Yaesu FT-270RH.

Nor will you find a dual-band FM mobile that offers the crossband full-duplex capability found in the 25-watt Yaesu FT-2700RH.

It shouldn't be surprising. We've been coming up with a lot of innovative concepts lately.

The FT-270RH measures just 2 x 6 x 7 inches. Conveniently fitting its high-power punch into many small spaces of your car. Places where other 45-watt mobiles just won't fit.

The FT-2700RH is small too. Smaller than other dual-banders. But with one big difference: a "DUP" button. Push it, and you're operating full duplex, 2 meters on one VFO, 440 MHz on the other. Each at 25 watts. So you can simultaneously transmit and receive in true telephone style.

Once installed, you'll find the FT-270RH and the FT-2700RH equally simple to operate. Just turn the rig on, dial up a frequency, select offset or duplex split, and you're on the air.

Each rig gives you 10 memories for storing your favorite frequencies. Dual VFO capability. A clean, uncluttered LCD display for easy readout. Push-button jumps through the band in 1 MHz steps. Band scanning with programmable upper and lower limits. And priority channel operation.

You don't even have to take your eyes off the road to determine your operating frequency and memory channel. An optional voice synthesizer announces them both at the push of a button on the microphone. The FT-2700RH announces both your 2-meter and 440 MHz operating frequencies.

Also, tone encode and encode/decode capability is programmable from the front panel, using an optional plug-in board.

So when you need a lot of power in a compact mobile radio, discover Yaesu's FT-270RH and FT-2700RH. There's nothing else like them on the road.

YAESU ✓83

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6851 Walthall Way, Paramount, CA 90723
(213) 633-4007

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Prices and specifications subject to change without notice.

KENWOOD

Pacesetter in amateur radio

Pocket-size performers!
TH-21AT/41AT

Kenwood's advanced electronic technology brings you a new standard in pocket/handheld transceivers! The TH-21AT/41AT features a high impact molded case and is designed to deliver convenient, reliable performance in a package so small, it will slip into your shirt pocket! It measures only 57 (2.24) W x 120 (4.72) H x 28 (1.1) D mm (inch) and only weighs 260 g (0.57 lb) with batteries. In typical Kenwood fashion these transceivers provide superior transmit and receive performance.

Both the 2 meter and 70 cm versions deliver one watt R.F. output on HI power and 150 mW low, for really extended battery life! Functional design includes three digit thumb-wheel switch for easy frequency selection along with a built-in 5 kHz UP-Shift switch and repeater offset switch. (±600 kHz or simplex, 2m version and ±5 MHz or simplex 70 cm version.)

Both the 2 meter and 70 cm pocket/handheld transceivers are available in standard or 16-key autopatch DTMF encoder versions. Kenwood thread-loc antenna connector is also provided.

See your authorized Kenwood dealer and take home a pocket full of 2 m or 70 cm performance today!

Optional accessories:

- HMC-1 headset with VOX
- SMC-30 speaker microphone
- PB-21 Ni-Cd 180 mAH battery
- DC-21 DC power supply
- BT-2 battery case
- EB-2 external C manganese/alkaline battery case
- SC-8 soft case for TH-21A/41A
- SC-8T soft case for TH-21AT/41AT
- TU-6 programmable sub-tone unit
- AJ-3 thread-loc to BNC female adapter

More information available from authorized dealers of Trio-Kenwood Communications, 1111 West Walnut Street, Compton, CA 90220.

TH-21A/41A
Standard versions.

TH-21AT/41AT
Specifications and prices are subject to change without notice or obligation.